“Reference Crop Evapotranspiration spatially interpolated and temporally distributed in Java”

Bachelor Thesis

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Summary

As the water scarcity in the agricultural sector increases, there is a greater demand for more efficient irrigation. With better predictions of the reference crop evapotranspiration (ET_o), more efficient irrigation scheduling can be done. The ET_o is the evapotranspiration rate from a reference surface, which resembles a uniform surface of green grass with adequate water. In this study a model has been made for determining the ET_o on Java. This model can calculate the interpolated ET_o at a certain location when the coordinates and the predicted wind speed at that location are given. These calculations can be carried out for each month and the average over the year. The grid size of the interpolation is 1 by 1 minute, which is about 1.84 by 1.84 kilometers.

For this study, data from 24 measurement stations on Java have been used. For 20 of these stations, the data has been supplied by the Food and Agriculture Organization of the United Nations (FAO). For the remaining 4 stations, the data has been supplied by the Indonesian National Agency for Meteorology, Climatology and Geophysics (BMKG). Also, altitude data from GEBCO has been used.

In this research, five methods have been used for predicting the ET_o. In each of these methods the ET_o is interpolated. Method 1 consists of interpolating the ET_o values calculated with data from the measurement stations, using triangle-based interpolation methods. In Method 2 the ET_o is divided into an aerodynamic and a radiation component, which are individually interpolated. In this method, the wind speed is partially excluded from these components, which means the given or predicted wind speed is used to calculate the ET_o. In Methods 3, 4 and 5 the ET_o is divided into four components representing the aerodynamic part, the radiation part, the psychometric constant and the saturation vapor pressure relationship. Here the wind speed is entirely excluded from these components. In Method 3 the psychometric constant is interpolated, in Method 4 it is calculated using the altitude data from GEBCO and in Method 5 it is calculated using the altitude given in the data from the measurement stations.

Method 1 had better results than Method 2, meaning plain interpolation is better than dividing the ET_o into two components and using the given or predicted wind speed. Methods 3, 4 and 5 all had better results than Method 1. Method 4 had worse results than Method 3, but better results than Method 5. Methods 4 and 5 both had worse results than Method 3, because the reduction of the error in the psychometric constant increased the overall error.

In a following research, Method 4 or 5 should be improved, because for those methods the sum of absolute errors of the components is lower.
The results showed that the model currently does not give good predictions for locations with high altitude differences with respect to their neighboring measurement locations. This is probably because the model does not yet take into account the temperature decrease at higher altitudes, this can be done in a future study. When the temperature is interpolated in a better way, the errors in all components except for the psychometric constant could decrease. Currently errors in these components cause most of the errors in the ET_o, so interpolating the temperature in a better way can greatly improve the model.
Also, with more measurement data the model would probably have been developed better, but these data could not be obtained within the time and resources available for this study. For a following research it is recommended that first more data is obtained.

Preface

I started with the preparation for my research and visit in Indonesia in the beginning of February this year. I did research on a model for predicting evapotranspiration in Java. The research was done in Bandung, at a rather quickly growing company called LabMath. I did research on the model for about three months there. There were some complications and I was ill in the first few weeks, but I think I managed to do the research quite well. The complications I speak of include a change of supervisor in Indonesia – because my first supervisor quit the company – and not being able to obtain more data in time. However, I think the model has developed quite well during the course of my research. While improvements can certainly be made, I am pleased with what the model can do now.

I think I learned a lot during my stay in Indonesia. Not only from doing my research, but also from living there. The culture and living circumstances in Indonesia are a lot different from those in Europe. There is a very big difference between rich and poor in Indonesia, the safety measures are rather poor and there is a lot of chaos. Because of my research I learned to work a lot better with MatLab, which will probably be very useful for my study and work in the future. I also learned that it is very hard to obtain reliable data in Indonesia.

I would like to give my thanks to a number of people who helped me during this research.

To start with, I would like to thank my supervisors Martijn Booij, “Dody” Satyanto Krido Saptomo and Brenny van Groesen for their good advice and support.

I would also like to thank all the students and staff at LabMath, for their help and friendliness. You were all good friends to me. A lot of you taught Ferdinand and me how to get around town and some of you even took us on very nice trips. Because of this, the office felt like a very warm place to me.

Next, I would like to thank Ferdinand. He also did his internship at LabMath and we stayed at the same student housing. He was really helpful and a good companion. I had a lot of fun with him in the weekends.

Lastly, I want to thank my family and friends for their care and support during my stay in Indonesia.

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1. Introduction

1.1. Problem context

The global climate conditions keep changing. These changes directly affect the water cycle and thus the individual components of the water balance. Due to this, Java faces various severe problems with water. Rivers are flooding in many areas, which causes great human, social and economic problems during the wet season. In the dry season and at several times in the wet season there is a severe shortage of water for human consumption, industrial use, agricultural use and natural vegetation. The dry season is taking longer, while the wet season is shorter with heavier rainfall intensity (Case, Ardiansyah, & Spector, 2007). According to the IPCC (2007), the condition will get even worse in the future. The freshwater availability is projected to decrease, more floods are projected and more droughts are expected in Southeast Asia.
Because of these changes, farmers more often face severe water shortages. This means they need to be very efficient with their irrigation water. For the calculation of the amount of efficient irrigation water in agriculture, evapotranspiration (ET) is an important factor, because ET is a source of irrigation water loss. A lot of water is used for the production of rice and cassava (Bulsink, 2008). However, there is no model that can easily predict the ET over all of Java for a few days ahead yet. This means farmers are often uncertain if they need to use irrigation water or not, while not much fresh water is available for irrigation (Safrina, 2009).

Also the type of crops is of great influence to the ET, because every crop has a different Leaf Area Index (LAI) and a different aerodynamic resistance. The aerodynamic resistance determines the transfer of heat and water vapor from the evaporating surface into the air and the LAI is determined by dividing the upper leaf surface by the surface area of the land beneath the vegetation. Deforestation will result in changes of energy and water budgets of land surface, which will cause local and regional environmental condition changes as the consequence. As shown by Olchev et. al. (2008), a deforestation of around 15% for agricultural and urban activities in Central Sulawesi will considerably increase ground evaporation by 21%. Uncontrolled urbanization causes an increase in overland run-off and river discharge which often results in flooding and landslides. Uncontrolled urbanization reduces the ground water, which is used by the agricultural sector. When the ground water level decreases, less water becomes available for direct human consumption and the environment.

There is a high uncertainty in what is going to happen in certain local or regional areas when the climate changes. A sensitive spatial averaging method is needed in view of the large spatial variability of the ET. When the climate changes, farmers cannot rely on their experience with the weather. A model is needed so that people can make well informed choices. This model needs to show farmers when they should use irrigation and what the effect of using other types of crops is. The model that has been developed in this study does not take into account the crop types at various locations. The ET for a specific reference crop is given instead, which can be converted into the ET for a specific crop type, by multiplying it with a crop dependent coefficient. What is important for this model is that it is not too complicated, but it should still give reliable results. In this research will be checked if an easy and reliable model can be made for predicting the ET, which uses the predicted wind speed as input. This is because a preliminary study showed that the spatial and seasonal variations of the ET are very dependent on the wind speed and less dependent on the temperature in Java (Widarta, 2009).

1.2. Objective and research questions

The goal of this research is formulated as follows:
Develop and apply a model for determining the reference crop evapotranspiration for Java spatially and temporally distributed, by using different interpolation methods where the measured or predicted wind speed is used as input.

From the research objective, the following research questions were derived:

1. *What are the relevant weather parameters which can be used as input for the model?*
    1.1. *Which data are needed?*
    1.2. *Which data are available?*
    1.3. *Are the available data reliable?*
2. *How do these relevant weather parameters relate to the reference crop evapotranspiration?*
    2.1. *Which equations are used to calculate potential evapotranspiration?*
    2.2. *How are these equations used in the (different versions of) the model?*
    2.3. *Which assumptions are made and what values are chosen for the different parameters?*
3. *Which spatial inter- and extrapolation methods should be used in the modeling of the reference crop evapotranspiration?*
    3.1. *Which interpolation methods are available and what are their pros and cons?*
    3.2. *Which spatial characteristics should the spatial inter- and extrapolation method be based on?*

1.3. Outline

In chapter 2 the various equations for calculating the reference crop evapotranspiration are shown. In particular, the FAO-56 Penman-Monteith equation and the calculation of the variables in this equation will be considered. Also an overview is given of the different variables and parameters used in the model. The values that are chosen for the different parameters are shown and the variables used as input for the model are shown.

In chapter 3 the study area, the measurement locations and the measurement data are discussed. Meteorological data from 24 stations on Java have been used, the locations of the stations are shown and the source of the data is discussed. Also the elevation data from GEBCO that is used in Method 4 of this model is discussed.

In chapter 4 the different modeling and interpolation methods are explained. In total 5 methods have been used in this research. Explained is how the predicted reference crop evapotranspiration is determined in each of these methods.

In chapter 5 the results of the different modeling methods and interpolation methods are shown. Also, the phenomena seen in the results and the limitations of this study will be discussed in this chapter.

In the final chapter, chapter 6, the conclusions of this research and recommendations for a possible following research are given.

In addition, at the end of this report four appendices are attached. In the first appendix a list of symbols used in the equations in this report can be found. The second appendix shows an overview of the model as implemented in MatLab. In this appendix also the input, output and options of the different files are explained. The format of the input files is also clarified. In the third and fourth appendix respectively the MatLab code and the numerical results can be found.

2. Calculation of the reference crop evapotranspiration

2.1. Deriving the FAO-56 Penman-Monteith equation

In the model that has been developed in this study, the reference crop evapotranspiration (ET_o) is calculated. For calculating this, the guidelines for computing crop water requirements from the FAO (Allen et. al., 1998) are used. All equations shown in this chapter are taken from these guidelines. A list of all symbols used in these equations can be found in Appendix I. The FAO derived a standard formula for the ET_o from the original Penman-Monteith evapotranspiration equation. The Penman-Monteith equation is as follows:

$$\lambda ET = \frac{\Delta(R_n - G) + \rho_a c_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma\left(1 + \frac{r_s}{r_a}\right)} \qquad \text{(eq. 2.1)}$$

Where:

λET: latent heat flux (representing the evapotranspiration) [MJ m^{-2} day^{-1}]
Δ: slope of the relationship between the saturation vapor pressure and temperature [kPa $°C^{-1}$]
R_n: net radiation [MJ m^{-2} day^{-1}]
G: soil heat flux density [MJ m^{-2} day^{-1}]
ρ_a: mean air density at constant pressure [kg m^{-3}]
c_p: specific heat at constant pressure [MJ kg^{-1} $°C^{-1}$]
e_s: saturation vapor pressure [kPa]
e_a: actual vapor pressure [kPa]
$(e_s - e_a)$: saturation vapor pressure deficit [kPa]
γ: psychometric constant [kPa $°C^{-1}$]
r_s: (bulk) surface resistance [s m^{-1}]
r_a: aerodynamic resistance [s m^{-1}]

The reference crop evapotranspiration is the evapotranspiration rate from a reference surface. It is assumed that there is sufficient water at the reference surface. The reference surface is assumed to have crops with the following characteristics:

"A hypothetical reference crop with an assumed crop height of 0.12 m, a fixed surface resistance of 70 s m^{-1} and an albedo of 0.23."

This means that the reference surface closely resembles an extensive surface of green grass of uniform height, actively growing, completely shading the ground and with adequate water.
As a result of the assumptions in the definition of the reference surface, a part of the Penman-Monteith equation can be evaluated. From the definition, the following is known:
$r_s = 70\ s\ m^{-1}$ (surface resistance)
$h = 0.12\ m$ (crop height)
$\alpha = 0.23$ (albedo or canopy reflection coefficient)

Using the crop height, the aerodynamic resistance can be calculated. The aerodynamic resistance (r_a) is calculated using the following equation:

$$r_a = \frac{ln\left[\frac{z_m - d}{z_{om}}\right] ln\left[\frac{z_h - d}{z_{oh}}\right]}{k^2\, u_z} \qquad \text{(eq. 2.2)}$$

Where:

z_m: height of wind measurements [m]
z_h: height of humidity measurements [m]
d: zero plane displacement height [m]

z_{om}: roughness length governing momentum transfer [m]
z_{oh}: roughness length governing transfer of heat and vapour [m]
k: von Karman's constant, 0.41 [-]
u_z: wind speed at height z [m s^{-1}]

The zero plane displacement height, the roughness length governing momentum transfer and the roughness length governing transfer of heat and vapor are calculated using the following equations:
$d = 2/3\, h$
$z_{om} = 0.123\, h$
$z_{oh} = 0.1\, z_{om}$
With h = 0.12 and all measurements taken at 2 m height, the aerodynamic resistance of the reference surface becomes:

$$r_a = \frac{ln\left[\frac{2 - 2/3 \cdot 0.12}{0.123 \cdot 0.12}\right] ln\left[\frac{2 - 2/3 \cdot 0.12}{0.1 \cdot 0.123 \cdot 0.12}\right]}{(0.41)^2\, u_2} = \frac{208}{u_2} \quad \text{(eq. 2.3)}$$

Also, the "$\rho_a c_p$"-fraction in the Penman-Monteith equation can be written differently. The values for ρ_a and c_p are calculated with the following equations:

$$\rho_a = \frac{P}{1.01(T_{mean} + 273)R} \quad \text{(eq. 2.4)}$$

Where:
P: atmospheric pressure [kPa]
T_{mean}: the mean of the monthly averaged maximum and minimum temperatures (measured at 2m height) [°C]
R: specific gas constant, 0.287 [kJ kg^{-1} K^{-1}]

$$c_p = \frac{\gamma \varepsilon \lambda}{P} \quad \text{(eq. 2.5)}$$

Where:
ε: ratio molecular weight of water vapour/dry air, 0.622 [-]
λ: latent heat of vaporization, 2.45 [MJ kg^{-1}]

So the equation for the "$\rho_a c_p$"-fraction becomes:

$$\rho_a c_p = \frac{P}{1.01(T_{mean} + 273)R} \cdot \frac{\gamma \varepsilon \lambda}{P} = \frac{\gamma \varepsilon \lambda}{1.01(T_{mean} + 273)R} \quad \text{(eq. 2.6)}$$
$$= \frac{\gamma \cdot 0.622 \cdot 2.45}{1.01(T_{mean} + 273) \cdot 0.287} = 5.257 \cdot \frac{\gamma}{T_{mean} + 273}$$

When this is multiplied by 86400 to calculate the ET_o per day and divided by 2.45 to transfer from [MJ $°C^{-1}$ day^{-1} m^{-2}] to [mm $°C^{-1}$ day^{-1}], the fraction becomes:

$$\rho_a c_p = \frac{86400}{2.45} \cdot 5.257 \cdot \frac{\gamma}{T_{mean} + 273} = 185396 \cdot \frac{\gamma}{T_{mean} + 273} \quad \text{(eq. 2.7)}$$

Also, a transfer factor is needed for the radiation part of the Penman-Monteith equation, to convert this from [MJ m^{-2} day^{-1}] to [mm day^{-1}]. This transfer factor is 0.408.

When all this is taken into account, the FAO-56 Penman-Monteith equation can be derived as follows:

$$ET_o = 0.408 \cdot \lambda ET = \frac{0.408 \cdot \Delta(R_n - G) + \rho_a c_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma\left(1 + \frac{r_s}{r_a}\right)}$$

$$= \frac{0.408 \cdot \Delta(R_n - G) + 185396 \cdot \frac{\gamma}{T_{mean} + 273} \cdot \frac{(e_s - e_a)}{208} \cdot u_2}{\Delta + \gamma\left(1 + \frac{70}{208} \cdot u_2\right)}$$

$$= \frac{0.408 \cdot \Delta(R_n - G) + \gamma \frac{900}{T_{mean} + 273} u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34 \cdot u_2)}$$

So the FAO-56 Penman-Monteith equation becomes:

$$ET_o = \frac{0.408 \cdot \Delta(R_n - G) + \gamma \frac{900}{T_{mean} + 273} u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34 \cdot u_2)} \qquad \text{(eq. 2.8)}$$

Where:
ET_o: reference evapotranspiration [mm day^{-1}]
u_2: wind speed at 2 m height [m s^{-1}]

2.2. Calculation of the variables in the FAO-56 Penman-Monteith equation

Slope of saturation vapour pressure curve (Δ)

$$\Delta = \frac{4098\left[0.6108 \cdot \exp\left(\frac{17.27 \cdot T_{mean}}{T_{mean} + 237.3}\right)\right]}{(T_{mean} + 237.3)^2} \qquad \text{(eq. 2.9)}$$

Net radiation at the crop surface (R_n)

$$R_n = R_{ns} - R_{nl} \qquad \text{(eq. 2.10)}$$

Where:
R_{ns}: net solar or shortwave radiation [MJ m^{-2} day^{-1}]
R_{nl}: net outgoing longwave radiation [MJ m^{-2} day^{-1}]

$$R_{ns} = (1 - \eta)R_s \qquad \text{(eq. 2.11)}$$

Where:
η: albedo or canopy reflection coefficient, 0.23 for the reference surface [-]
R_s: incoming solar or shortwave radiation [MJ m^{-2} day^{-1}]

$$R_{nl} = \sigma\left[\frac{{T_{max,K}}^4 + {T_{min,K}}^4}{2}\right]\left(0.34 - 0.14\sqrt{e_a}\right)\left(1.35\frac{R_s}{R_{so}} - 0.35\right) \qquad \text{(eq. 2.12)}$$

Where:
σ: Stefan-Boltzmann constant, $4.903 \cdot 10^{-9}$ [MJ K^{-4} m^{-2} day^{-1}]
$T_{max,K}$: maximum absolute temperature during the 24-hour period [K]
$T_{min,K}$: minimum absolute temperature during the 24-hour period [K]
R_s/R_{so}: relative shortwave radiation (limited to ≤ 1.0) [-]
R_{so}: clear-sky radiation [MJ m^{-2} day^{-1}]

$$R_s = \left(a_s + b_s \frac{n}{N}\right) R_a \quad \text{(eq. 2.13)}$$

Where:

n: actual duration of sunshine [hour]

N: daylight hours [hour]

n/N: relative sunshine duration [-]

R_a: extraterrestrial radiation [MJ m^{-2} day^{-1}]

a_s: regression constant, expressing the fraction of extraterrestrial radiation reaching the earth on overcast days (n = 0)

b_s: additional regression constant, expressing the extra fraction of extraterrestrial radiation reaching the earth during sunshine hours

$a_s + b_s$: fraction of extraterrestrial radiation reaching the earth on clear days (n = N)

$$R_{so} = (a_s + b_s) R_a \quad \text{(eq. 2.14)}$$

$$N = \frac{24}{\pi} \omega_s \quad \text{(eq. 2.15)}$$

Where:

ω_s: sunset hour angle [rad]

$$\omega_s = \arccos[-tan(\varphi) \cdot tan(\delta)] \quad \text{(eq. 2.16)}$$

Where:

φ: latitude [rad]

δ: solar decimation [rad]

$$R_a = \frac{24 \cdot 60}{\pi} G_{sc} d_r [\omega_s \sin(\varphi) \sin(\delta) + \cos(\varphi) \cos(\delta) \sin(\omega_s)] \quad \text{(eq. 2.17)}$$

Where:

G_{sc}: solar constant, 0.0820 [MJ m^{-2} min^{-1}]

d_r: inverse relative distance Earth-Sun

$$d_r = 1 + 0.033 \cos\left(\frac{2\pi}{365} J\right) \quad \text{(eq. 2.18)}$$

Where:

J: number of the day in the year from 1 (1 January) to 365 or 366 (31 December)

$$\delta = 0.409 \sin\left(\frac{2\pi}{365} J - 1.39\right) \quad \text{(eq. 2.19)}$$

$$J = \text{INTEGER}(30.4 \cdot M - 15) \quad \text{(eq. 2.20)}$$

Where:

M: number of the month in the year from 1 (January) to 12 (December)

Soil heat flux density (G)

When assuming a constant soil heat capacity of 2.1 MJ m^{-3} $°C^{-1}$ and an appropriate soil depth, equation 2.21 can be derived for G for monthly periods. These assumptions may be very rough, but the soil heat flux is very small compared to R_n (and as seen in equation 2.8 it is subtracted from that) and can often even be ignored, so the rough assumptions only cause very small errors.

$$G_{month,i} = 0.07(T_{month,i+1} - T_{month,i-1}) \quad \text{(eq. 2.21)}$$

Where:

$G_{month,i}$: soil heat flux density in month i [MJ m^{-2} day^{-1}]

$T_{month,i+1}$: the mean of the monthly averaged maximum and minimum temperatures in the next month (measured at 2m height) [°C]

$T_{month,i-1}$: the mean of the monthly averaged maximum and minimum temperatures in the previous month (measured at 2m height) [°C]

Psychometric constant (γ)

$$\gamma = \frac{c_p P}{\varepsilon \lambda} = 0.665 \cdot 10^{-3} P \quad \text{(eq. 2.22)}$$

$$P = 101.3 \left(\frac{293 - 0.0065 \cdot z}{293}\right)^{5.26} \quad \text{(eq. 2.23)}$$

Where:

z: elevation above sea level [m]

Saturation vapor pressure (e_s) and actual vapor pressure (e_a)

$$e_s = \frac{e°(T_{max}) + e°(T_{min})}{2} \quad \text{(eq. 2.24)}$$

Where:

$e°(T)$: saturation vapour pressure at the air temperature T [kPa]

T_{max}: mean of the daily maximum temperatures taken over the month [°C]

T_{min}: mean of the daily minimum temperatures taken over the month [°C]

$$e_a = \frac{RH_{mean}}{100} \left[\frac{e°(T_{max}) + e°(T_{min})}{2}\right] \quad \text{(eq. 2.25)}$$

Where:

RH_{mean}: the mean relative humidity [-]

This is a less desirable equation for calculating the actual vapor pressure, but psychometric data was not available and only the mean relative humidity is given.

$$e°(T) = 0.6108 \cdot exp\left(\frac{17.27 \cdot T}{T + 237.3}\right) \quad \text{(eq. 2.26)}$$

Where:

T: the air temperature (measured at 2m height) [°C]

2.3. FAO-56 Penman-Monteith variables and parameters

In the following schedule a very basic overview is given of the relation between the parameters and variables in the calculation of the reference crop evapotranspiration. In this model, parameters are constants, which means they have only one value in the entire model. Variables on the other hand, have different values depending on the time and/or location of the measurements they relate to. In this schedule, the blue blocks stand for variables and the orange blocks stand for parameters. Under each gray block are blocks with therein the input needed to calculate the value of the quantity the gray block represents.

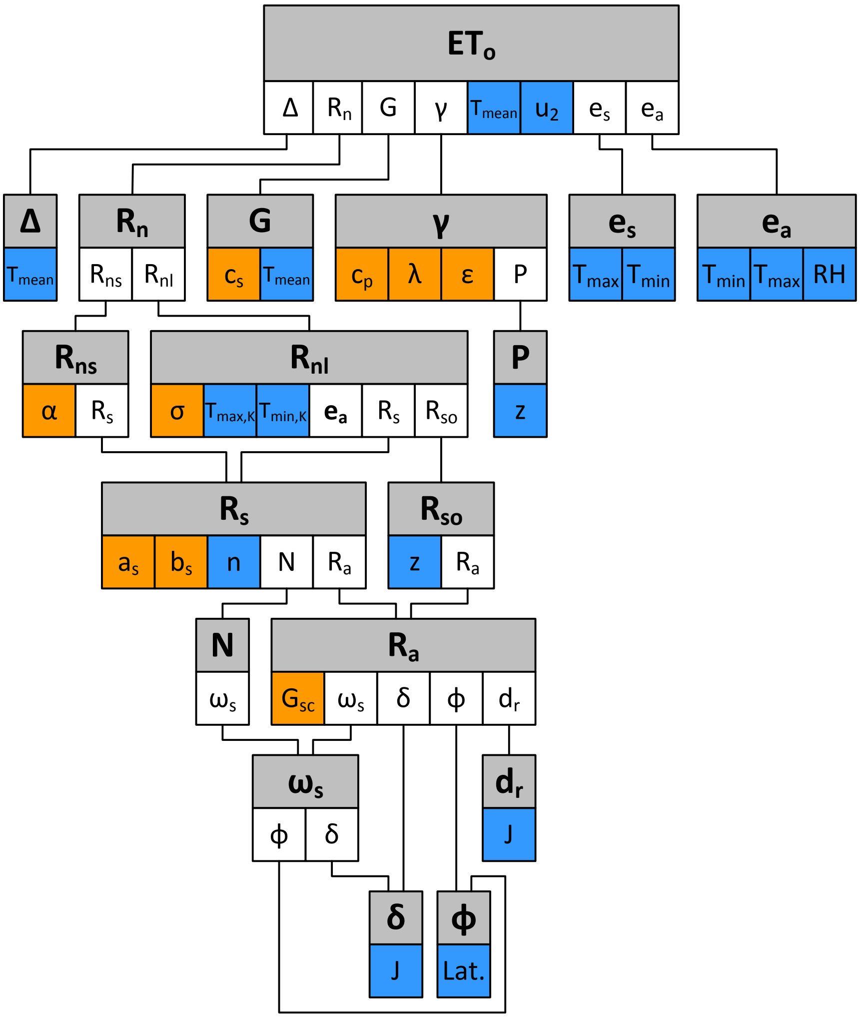


Figure 2.1: Schedule of the variables and parameters in the model.

As can be seen in figure 2.1, the temperature is used as input variable in many places in the model. None of the used modeling methods in this research have been based on interpolating the temperature better, because the general consensus was that the temperature doesn't vary very much over Java. Also, interpolating the temperature better is a very complex task when it is used at so many places and in so many different forms in the model. The different forms being the mean temperature in °C, the maximum temperature in °C, the minimum temperature in °C, the maximum temperature in K and the minimum temperature in K. The fact that γ only uses the altitude as an input variable was used in Methods 4 and 5.

2.3.1. Parameters used in the model

As can be seen in the schedule above, the parameters used in the model are the following:

c_p = 1.013 · 10^{-3} [MJ kg^{-1} $°C^{-1}$], specific heat at constant pressure
λ = 2.45 [MJ kg^{-1}], latent heat of vaporization
ε = 0.622 [-], ratio molecular weight of water vapor/dry air
α = 0.23 [-], albedo or canopy reflection coefficient
σ = 4.903 · 10^{-9} [MJ K^{-4} m^{-2} day^{-1}], Stefan-Boltzmann constant
a_s = 0.25 [-], regression constant, expressing the fraction of extraterrestrial radiation reaching the earth on overcast days (n = 0)
b_s = 0.50 [-], additional regression constant, expressing the extra fraction of extraterrestrial radiation reaching the earth during sunshine hours
$a_s + b_s$ = 0.75 [-], fraction of extraterrestrial radiation reaching the earth on clear days (n = N)
G_{sc} = 0.0820 [MJ m^{-2} min^{-1}], solar constant

Depending on atmospheric conditions (humidity, dust) and solar declination (latitude and month), the Angstrom values a_s and b_s will vary. But because no actual solar radiation data are available and no calibration has been carried out for improved a_s and b_s parameters, the recommended values a_s = 0.25 and b_s = 0.50 are used.

2.3.2. Variables used as model input

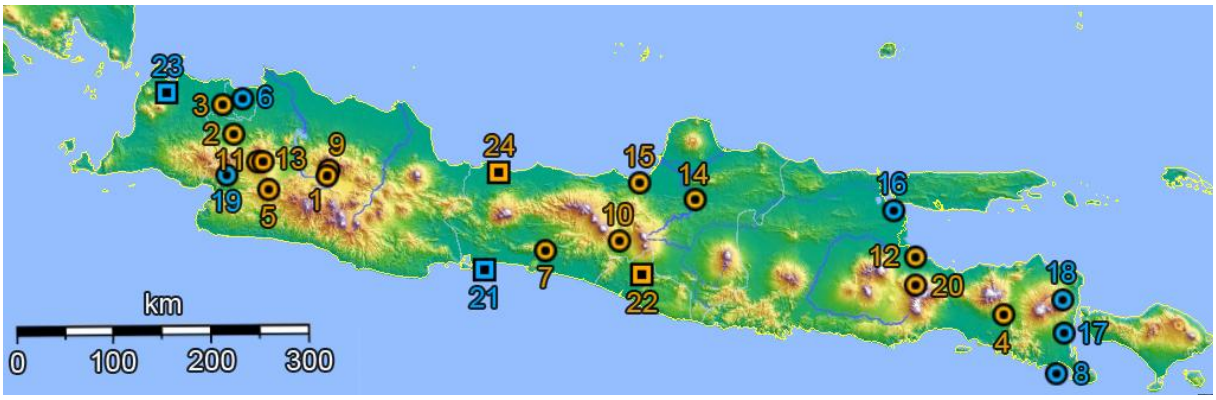
The following variables are used as input for the model:

- T_{max}: The mean maximum temperature for each month
- T_{min}: The mean minimum temperature for each month
- The latitude and longitude of the measurement location
- z: The elevation of the ground above sea level on the measurement location
- n: The mean actual daily sunshine hours for each month
- RH_{mean}: The mean relative air humidity for each month
- u_2: The wind speed for each month (measured at 2m height)

3. Study area and data

3.1. Study area and measurement locations

The study area of this research is the island Java, which is part of Indonesia. Java has a tropical climate. It basically has only two seasons; wet and dry. The wet season is from November until April and the dry season is from May until October. A map of the study area is shown in figure 3.1. In this map the locations of the 24 different measurement stations are shown (so these are not the locations of the cities, but the locations of the measurement stations at those cities). The locations shown in blue are boundary locations of the interpolation surface, meaning that they cannot be used as control data, for extrapolation would be needed then. Control data is data that is excluded when creating the interpolation surface, because it is used for validation of the model. This means that, when one of the boundary locations is taken away, the area over which can be interpolated becomes smaller, so the boundary locations determine the shape of the surface. The remaining locations are shown in orange. The locations marked with a square are locations with data supplied by BMKG and the locations marked with a circle are locations with data supplied by FAO.



= Data from FAO and a boundary location
= Data from FAO and not a boundary location
= Data from FAO and a boundary location
= Data from FAO and not a boundary location

Measurement locations:

1. Bandung
2. Bogor
3. Curug-Budiarto
4. Djember
5. Gunung Rosa
6. Jakarta
7. Karang Anjar
8. Kawah-Idjen
9. Lembang
10. Magelang
11. Pangerango
12. Pasuruan
13. Rarahan
14. Sawahan
15. Semarang
16. Surabaya
17. Rogodjampi
18. Tamansari
19. Tjipetir
20. Tosari
21. Cilacap
22. Yogyakarta
23. Serang
24. Tegal

Figure 3.1: Map of Java with locations of the measurement stations

As can be seen in figure 3.1, the locations of the measurement stations are not very well distributed over the area. This means that in some areas because of this the interpolation will be better and in some areas it will be very bad. The biggest amount of measurement stations is located in the western part of Java. Two other 'groups' of measurement stations can be seen respectively in the middle and in the eastern part of Java. For making better interpolation possible between these 'groups' of measurement stations, data from more measurement stations will be needed.

3.2. Meteorological data

Data of the 24 meteorological stations (in the locations shown in the previous paragraph) on Java have been used in this research. For 20 of these stations, the data has been supplied by the Food and Agriculture Organization of the United Nations (FAO). For the remaining 4 stations, the data has been supplied by the Indonesian National Agency for Meteorology, Climatology and Geophysics (BMKG). The data contains values for all variables listed in section 2.3.2. The following table shows the source of the data for all 24 measurement locations.

Number	Location	Source
1	Bandung	FAO
2	Bogor	FAO
3	Curug Budiarto	FAO
4	Djember	FAO
5	Gunung Rosa	FAO
6	Jakarta	FAO
7	Karang Anjar	FAO
8	Kawah-Idjen	FAO
9	Lembang	FAO
10	Magelang	FAO
11	Pengerango	FAO
12	Pasuruan	FAO

Number	Location	Source
13	Rarahan	FAO
14	Sawahan	FAO
15	Semarang	FAO
16	Surabaya	FAO
17	Rogodjampi	FAO
18	Tamansari	FAO
19	Tjipetir	FAO
20	Tosari	FAO
21	Cilacap	BMKG
22	Yogyakarta	BMKG
23	Serang	BMKG
24	Tegal	BMKG

Table 3.1: Locations of the used measurement stations and the source of their climate data

FAO data

The data from FAO comes from a climatic database called "CLIMWAT" (FAO, 1994). This database was published in 1994, so the climate data in it is quite old. The database contains monthly values for the variables used as model input. These monthly values are averaged over years of climatic data. The individual values for these years however are not given in the database. Table 3.2 below shows in which dimensions and with which precisions this data is given.

Climate data	Dimension	Precision
Longitude	[degrees, minutes]	1 minute
Latitude	[degrees, minutes]	1 minute
Elevation	[m]	1 metre
Mean maximum temperature	[°C]	0.1 degrees
Mean minimum temperature	[°C]	0.1 degrees
Relative air humidity	[%]	1%
Wind speed measured at 2m	[km day^{-1}]	1 km/day
Daily sunshine hours	[hours]	0.1 hours

Table 3.2: Dimensions and precision of the FAO climate data

BMKG data

The data from BMKG was given in an Excel sheet. In this sheet, data was given for the years 2000 to 2006 for every month. In the model the average from the years 2000 until 2006 is used as input. Table 3.3 below shows in which dimensions and with which precisions this data is given.

Climate data	Dimension	Precision
Longitude	[degrees, minutes]	1 minute
Latitude	[degrees, minutes]	1 minute
Elevation	[m]	1 metre
Mean maximum temperature	[°C]	0.1 degrees
Mean minimum temperature	[°C]	0.1 degrees
Relative air humidity	[%]	0.1%
Wind speed measured at 10m	[knots]	1 knot
Daily sunshine hours	[hours]	0.1 hours

Table 3.3: Dimensions and precision of the BMKG climate data

Longitude and latitude data

The precision of the longitudes and latitudes given are 1 minute. This is equal to about 1.85 kilometers. On a national scale this is not a big deal, but on a local scale it matters quite much. The model is supposed to be used by farmers on a local scale, so the coordinates should be given with a higher precision in the future.

Wind speed data

The wind speed data supplied by FAO does not seem to be correct for all the measurement stations. The wind speeds are very low compared to the wind speeds in the BMKG data. Sometimes the measured wind speed does not even vary during the year. This means that the dependence between the wind speed and the variations of the reference crop evapotranspiration does not apply at those locations. This probably did not make the result of the model better, but no better wind data was available during the course of this study. The wind speed in knots measured at 10 meters height was converted to the wind speed in [m s^{-1}] measured at 2 meters height. Probably the differences are due to different ways of measuring.

The conversion from knots at 10 meters height ($u_{10}(\text{knots})$) to meters per second at 2 meters height ($u_2(\text{m/s})$) was done in the following way. One knot is equal to exactly 1.852 km/h and one m/s is equal to exactly 3.6 km/h, so equation 3.1 below is used to get from the wind speed in knots to the wind speed in m/s at 10 meters height ($u_{10}(\text{m/s})$):

$$u_{10}(\text{m/s}) = \frac{u_{10}(\text{knots}) \cdot 1.852}{3.6} = \frac{463}{900} \cdot u_{10}(\text{knots}) \qquad \text{(eq. 3.1)}$$

Then the wind speed in m/s at 10 meters height needs to be converted into the wind speed in m/s at 2 meters height. This is done by using a conversion factor from Annex 2 in Allen et. al. (1998). This conversion factor is calculated as shown in equation 3.2. In this equation z is the original height of the measurement, so in this case 10. The calculated conversion factor is then multiplied with the wind speed in m/s at 10 meters height to come to the wind speed in m/s at 2 meters height, as shown in equation 3.3.

$$\text{conversion factor} = \frac{4.87}{\ln{(67.8 \cdot z - 5.42}} = \frac{4.87}{\ln{(67.8 \cdot 10 - 5.42}} = 0.748 \qquad \text{(eq. 3.2)}$$

$$u_2(\text{m/s}) = 0.748 \cdot u_{10}(\text{m/s}) \qquad \text{(eq. 3.3)}$$

3.3. Elevation data

In this research altitude data of the research area was also used. This data has been provided through the GEBCO Grid Display software (GEBCO, 2009). GEBCO's main goal is providing bathymetric charts of the oceans, but they also have data of the altitudes over land. The land data is largely derived from the Shuttle Radar Topography Mission (SRTM30) data set. The data has 30 arc-seconds spacing, which is about 0.92 kilometers. Considering that the longitudes and latitudes provided by the measurement stations are provided with an accuracy of 60 arc-seconds, the spacing of this altitude data should be accurate enough.

Figure 3.2 below gives an overview of the altitude data in the research area:

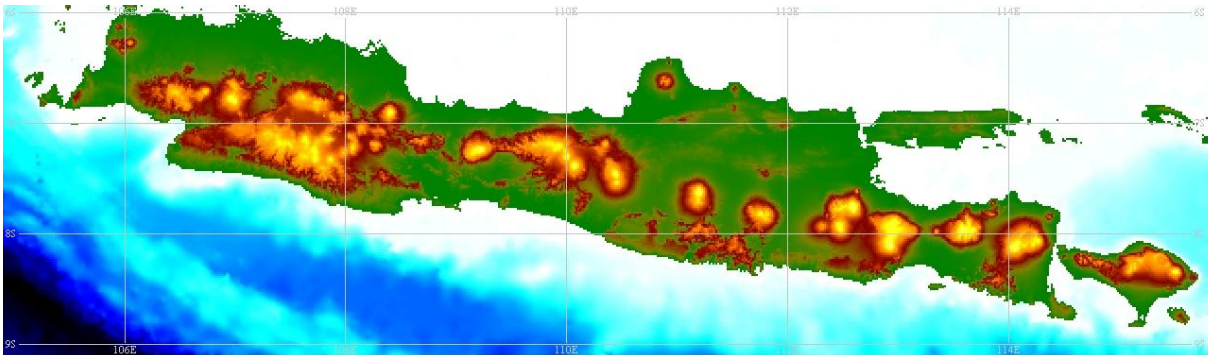


Figure 3.2: Altitude data of Java with 30 arc-seconds spacing.

Figure 3.2 shows that not only the altitude data of the land of Java is given, but also the bathymetry of the sea around it. In the model this data is converted into another matrix where the bathymetry data is left out as this is not needed in the model.

4. Modeling and interpolation methods

In this research various methods have been used to interpolate the ET_o. In total 5 methods have been used. The first method is just plainly interpolating the ET_o. In the second method the ET_o was split up into three components; α, β and u_2. Here α and β were interpolated and the measured wind speed was used after the interpolation. In the third method the ET_o was split up into five components; $\hat{\alpha}$, $\hat{\beta}$, γ, Δ and u_2. Here $\hat{\alpha}$, $\hat{\beta}$, γ and Δ were interpolated and the measured wind speed was used after the interpolation. In the third method, none of the interpolated components contain u_2 anywhere, while α and β still contained u_2 in the second method. The fourth method is the same as the third method, except for that the γ is not interpolated, but calculated using the GEBCO elevation data. The fifth method is also the same as the third method, except for that the γ is not interpolated, but calculated using the altitude given in the data from the measurement locations.

For each of these methods the results were obtained in the following way. For every station not on the boundary the model was run thirteen times, once for each month and once for the average over the year. When the model is run for a certain station, this means that this certain station is left out in the interpolation process and the data of that station is thus used as control data (used for validation). It has been chosen to only take one station as a control point at a time, because of the small amount of measurement locations with available data. However, with the model it is possible to take multiple stations as control points in the same run.

Now the different methods will be explained in more detail.

4.1. Interpolation methods in MatLab

The interpolation is done using the griddata function in MatLab, this function can use 4 different interpolation methods. These four methods are:

- triangle-based linear interpolation
- triangle-based cubic interpolation
- nearest neighbor interpolation
- the MATLAB v4 griddata method

Of these four methods only two methods were found to be useful. The nearest neighbor interpolation is not much of an interpolation, because it generates no new values and this is not what is wanted in this model. The MATLAB v4 griddata method gave very bad results (a big difference between the ET_o calculated from interpolation and the ET_o calculated from measurements) and it is also not very clear what it was actually doing, while the model should be simple and as accurate as possible. The MATLAB v4 griddata method could also extrapolate, but this did not make much sense as no hard boundary was defined in the model. With this method the calculation time of the model also increased by about a factor 4. The triangle-based linear and cubic interpolation methods were used to obtain results. The cubic method was only used in Method 1 and Method 2, after which it was abandoned because the linear method gave way better results. Triangle-based linear interpolation actually makes more sense. This is because the cubic method makes the interpolation surface look smoother, while the linear method makes the interpolation surface consist of triangular planes. However, the smoothness has no physical ground. This means the cubic method may make the interpolation surface look better, but it won't make better numerical results. In Methods 3, 4 and 5 only triangle-based linear interpolation is used for obtaining results.

4.2. Modeling methods

In the sub-paragraphs of this paragraph (4.2.1 to 4.2.5) the details of the 5 different methods are given. For each method is first explained in which components the ET_o is divided in these sub-paragraphs.

In Method 1, first the ET_o is calculated for each point that is not a control point. In Methods 2 to 5, first the values of the components are calculated for each point that is not a control point. Then there are a certain amount of points that have coordinates (longitude and latitude) and a value for the components (and in Method 1 for the ET_o). These points are then used to make interpolation surfaces, one for each of the components (and in Method 1 for the ET_o). The interpolation surfaces are actually a gridded matrices with values of the different components or the ET_o in them. The interpolations are done separately for each month and also for the averaged values over the year.

The values for the components and the ET_o are also calculated for the control points, but these were not used to generate the interpolation surfaces. Then the coordinates of the control points are used to find the predicted value of the components (and in Method 1 of the ET_o) for the control points in the gridded matrices. In Methods 2 to 5 the value for u_2 is taken from the measurement data at the control point. This is because when the model is ready, the predicted wind speed can be entered in the model here.

When there is a control point C, which has location (x_C , y_C), where x_C and y_C are the longitude and latitude in decimal degrees respectively. Then the predicted ET_o at control point C in a specific month M can approximately be determined. Approximately, because the exact values of x_C and y_C are not always on the axes of the interpolation surface, but the nearest points on the axes are taken. The equation for calculating the predicted ET_o for each method is given in the sub-paragraph of that method. The values of the predicted ET_o and the ET_o as calculated using all the measurement data at the control point can then be compared.

4.2.1. Method 1: Interpolating the ET_o

In this model the FAO-56 Penman-Monteith equation (equation 2.8) is used to calculate the ET_o. In this method the ET_o as calculated by this equation is interpolated directly.

In this method, the predicted ET_o at control point C in a specific month M is approximately given by:

$$ET_{o_{predicted}}(C, M) = ET_{o_{surface}}(x_C, y_C, M) \quad \text{(eq. 4.1)}$$

4.2.2. Method 2: The α and β method

The FAO-56 Penman-Monteith equation (equation 2.8) can be written in the following form:

$$ET_o = \alpha + \beta \cdot u_2 \quad \text{(eq. 4.2)}$$

Where:

$$\alpha = \frac{0.408 \cdot \Delta(R_n - G)}{\Delta + \gamma(1 + 0.34 \cdot u_2)} \quad \text{(eq. 4.3)}$$

$$\beta = \frac{\gamma \frac{900}{T_{mean} + 273}(e_s - e_a)}{\Delta + \gamma(1 + 0.34 \cdot u_2)} \quad \text{(eq. 4.4)}$$

u_2: measured wind speed at 2 m height [m s^{-1}]

In this method α and β are the components which are interpolated separately.

In this method we assume that we have a prediction p of the wind speed in month M at point C in noted as $u_2(C, M, p)$. Then the predicted ET_o at control point C in month M is approximately given by:

$$ET_{o_{predicted}}(C, M) = \alpha_{surface}(x_C, y_C, M) + \beta_{surface}(x_C, y_C, M) \cdot u_2(C, M, p) \qquad \text{(eq. 4.5)}$$

4.2.3. Method 3: The abcd method

The FAO-56 Penman-Monteith equation (equation 2.8) can be written in the following form:

$$ET_o = \frac{\hat{\alpha} \cdot \Delta + \hat{\beta} \cdot \gamma \cdot u_2}{\Delta + \gamma(1 + 0.34 \cdot u_2)} \qquad \text{(eq. 4.6)}$$

Where:

$$\hat{\alpha} = 0.408(R_n - G) \qquad \text{(eq. 4.7)}$$

$$\hat{\beta} = \frac{900}{T_{mean} + 273}(e_s - e_a) \qquad \text{(eq. 4.8)}$$

γ: psychrometric constant [kPa °C^{-1}]

Δ: slope of the relationship between the saturation vapor pressure and temperature [kPa °C^{-1}]

u_2: measured wind speed at 2 m height [m s^{-1}]

In this method $\hat{\alpha}$, $\hat{\beta}$, γ *and* Δ are the components which are interpolated separately. This method is called "The abcd method" because the first four letters in the Greek alphabet are interpolated. The main goal of this method was to exclude u_2 entirely from the interpolation, because α and β did still contain u_2 in their equations (equations 4.3 and 4.4).

In this method we assume that we have a prediction p of the wind speed in month M at point C in noted as $u_2(C, M, p)$. Then the predicted ET_o at control point C in month M is approximately given by:

$$ET_{o_{predicted}}(C, M) = \frac{\hat{\alpha}_{predicted} \cdot \Delta_{predicted} + \hat{\beta}_{predicted} \cdot \gamma_{predicted} \cdot u_2(C, M, p)}{\Delta_{predicted} + \gamma_{predicted}(1 + 0.34 \cdot u_2(C, p))} \qquad \text{(eq. 4.9)}$$

Where:

$$\hat{\alpha}_{predicted} = \hat{\alpha}_{surface}(x_C, y_C, M) \qquad \text{(eq. 4.10)}$$

$$\hat{\beta}_{predicted} = \hat{\beta}_{surface}(x_C, y_C, M) \qquad \text{(eq. 4.11)}$$

$$\gamma_{predicted} = \gamma_{surface}(x_C, y_C) \qquad \text{(eq. 4.12)}$$

$$\Delta_{predicted} = \Delta_{surface}(x_C, y_C, M) \qquad \text{(eq. 4.13)}$$

Note that the predicted γ does not depend on the month, this is because γ only depends on the altitude, which doesn't change during the year.

4.2.4. Method 4: The abcd method, but using altitude data for determining γ

This method is the same as Method 3, except for the fact that the $\gamma_{surface}$ is determined in another way. The elevation data from GEBCO (see section 3.3) is used to calculate the values for $\gamma_{surface}$. In figure 2.1 can be seen that γ only depends on the altitude. This can also be seen in equations 2.22 and 2.23.

When the values for the parameters are entered into the equation for γ (equation 2.22) and P in that equation is substituted with the right part of equation 2.23 the following equation is obtained:

$$\gamma = 0.665 \cdot 10^{-3} \cdot 101.3 \left(\frac{293 - 0.0065 \cdot z}{293}\right)^{5.26} \quad \text{(eq. 4.14)}$$

As described in paragraph 3.3, altitude data of Java was available for this research. This altitude data can be put into a matrix. Assume this matrix contains i rows and j columns, then every cell of the matrix contains an altitude $z_{i,j}$. Now equation 4.14 can be used to make a $\gamma_{surface}$ in the following way:

$$\gamma_{i,j} = 0.665 \cdot 10^{-3} \cdot 101.3 \left(\frac{293 - 0.0065 \cdot z_{i,j}}{293}\right)^{5.26} \quad \text{(eq. 4.15)}$$

If this is done for i from 1 to the amount of rows in the altitude matrix and for j from 1 to the amount of columns in the altitude matrix, $\gamma_{surface}$ is obtained. With this new $\gamma_{surface}$ equation 4.9 and the underlying equations (4.10 until 4.13) can be applied to obtain the new predicted values for ET_o at the control points.

4.2.5. Method 5: The abcd method, but using the given height to determine γ

This method is the same as Method 3, except for the fact that the γ is not predicted. In this method the assumption is made that the altitude belongs to the input of the model. When the longitude and latitude can be given, then it might be a small step to also add the altitude to that. This means there will be no error due to γ in the predicted ET_o.
In this method the predicted ET_o at control point C in month M is approximately given by:

$$ET_{o_{predicted}}(C,M) = \frac{\hat{\alpha}_{predicted} \cdot \Delta_{predicted} + \hat{\beta}_{predicted} \cdot \gamma(z(C)) \cdot u_2(C,M,p)}{\Delta_{predicted} + \gamma(z(C)) \cdot (1 + 0.34 \cdot u_2(C,p))} \quad \text{(eq. 4.16)}$$

Where:

$$\hat{\alpha}_{predicted} = \hat{\alpha}_{surface}(x_C, y_C, M) \quad \text{(eq. 4.10)}$$

$$\hat{\beta}_{predicted} = \hat{\beta}_{surface}(x_C, y_C, M) \quad \text{(eq. 4.11)}$$

$$\gamma(z(C)) = 0.665 \cdot 10^{-3} \cdot 101.3 \left(\frac{293 - 0.0065 \cdot z(C)}{293}\right)^{5.26} \quad \text{(eq. 4.17)}$$

$$\Delta_{predicted} = \Delta_{surface}(x_C, y_C, M) \quad \text{(eq. 4.13)}$$

5. Results and discussion

In this chapter the results of the research are shown. The results will be discussed for every method. The results will be looked at from a per month view and a per station view. After the results are shown, the results will be discussed in more detail.

5.1. Results

In the results mostly errors are shown. Errors are interesting, because they show how good the interpolation is in comparison to the calculation from measurements. The error is defined as the relative difference between the predicted values and the values as calculated from measurements (CfM). The errors are calculated in the following way:

$$error = \frac{(predicted\ value) - (value\ as\ CfM)}{(value\ as\ CfM)} \qquad \text{(eq. 5.1)}$$

This means that when the error is positive, the predicted value is higher than the value as calculated from measurements. When the error is negative, the predicted value is lower than the value as calculated from measurements.

All errors as shown here are errors in the ET_o. For example, when an error is called "Error due to error in alpha", this means that the $ET_o$is calculated in two ways. In the case of the error due to alpha in Method 2 (the α and β method), the "predicted value" and "value as calculated from measurements" in equation 5.1 are calculated in the following way:

$$predicted\ value = \alpha_{predicted} + \beta_{CfM} \cdot u_{2,measured} \qquad \text{(eq. 5.2)}$$

$$value\ as\ CfM = \alpha_{CfM} + \beta_{CfM} \cdot u_{2,measured} \qquad \text{(eq. 5.3)}$$

5.1.1. Monthly errors

First the errors will be shown per month for every method. The errors shown in this paragraph (5.1.1) are all averaged over all the stations used as control points. The monthly errors for Method 1 with both linear and cubic triangle-based interpolation are shown in figure 5.1 below.

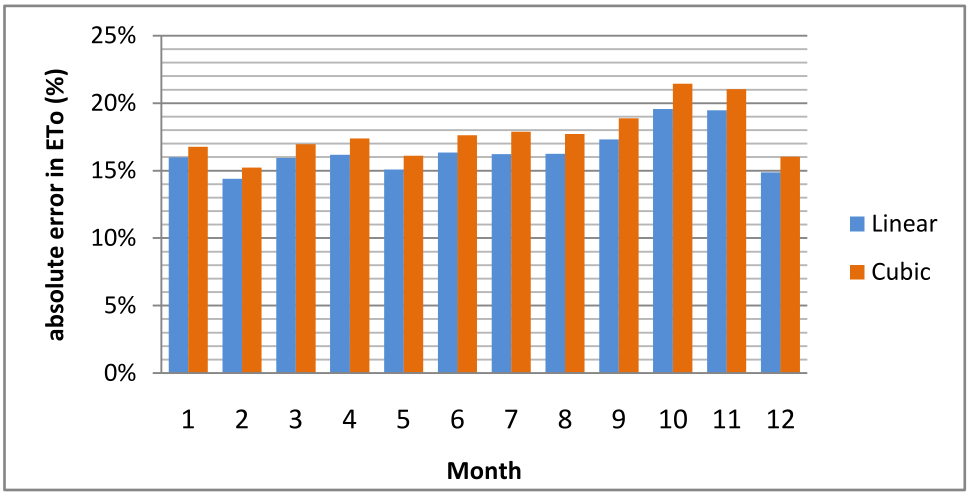


Figure 5.1: Method 1 - monthly errors for linear and cubic interpolation

The errors shown in figure 5.1 are absolute errors, this means that only the size of the error is displayed and not if the error is positive or negative. This is done because the errors become very small when averaging positive and negative errors, so then they don't give a good representation of the results. As can be seen, the error with cubic interpolation is bigger than the error with linear interpolation for each month. The errors are the biggest in October and November with 21,4% and 21,0% respectively for cubic and 19,6% and 19,5% respectively for linear.

For Method 2, the alpha and beta method, the distribution of monthly errors looks different. The monthly errors for Method 2 with both linear and cubic triangle-based interpolation are shown in figure 5.2 below.

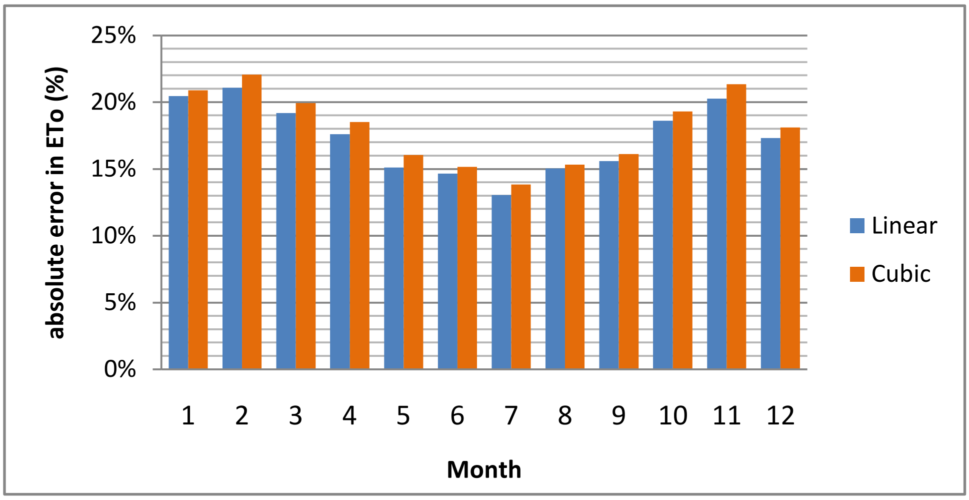


Figure 5.2: Method 2 - monthly errors for linear and cubic interpolation

The errors shown in figure 5.2 are also absolute errors. As can be seen, again the error with cubic interpolation is bigger than the error with linear interpolation for each month. Because cubic triangle-based interpolation was worse for every month and over 70% of the measurement stations used as control points in both Method 1 and 2, this method is not used in Methods 3, 4 and 5. On average, the errors of Method 2 are bigger than the errors of Method 1. The average errors of each method are presented in the paragraph named "Average errors per method". The errors are the biggest in January, February and November with 20.9%, 22.1% and 21.4% respectively for cubic and 20.5%, 21.1% and 20.3% respectively for linear.

The influence of alpha and beta to the error in ET_o is also an interesting thing to look at in this method. The error due to alpha is the error in ET_o that occurs when the error in beta is set to zero and the error due to beta is the error in ET_o that occurs when the error in alpha is set to zero. Figure 5.3 shows the absolute errors due to alpha and beta with linear interpolation.

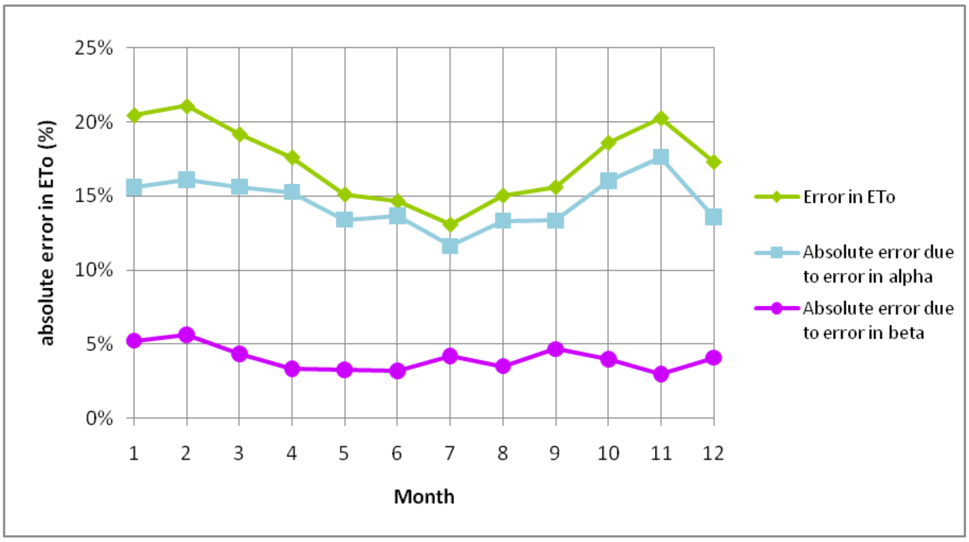


Figure 5.3: Method 2 - monthly errors due to alpha and beta for linear interpolation

The errors shown here are absolute errors, this means only the size of the error is shown and not if the errors are negative or positive. As can be seen, the biggest part of the error in the $ET_0$is caused by errors in alpha. Also, the error due to alpha varies more during the year than the error due to beta. The error in the ET_0in November is mainly caused by the error in alpha, because the error in beta is actually very low here, while this month has one of the highest errors in the ET_0.

For methods 3, 4 and 5, the distribution of monthly errors looks a lot like the distribution of errors in Method 1. The monthly errors in the ET_0 for Methods 3, 4 and 5 with only linear triangle-based interpolation are shown in figure 5.4 below.

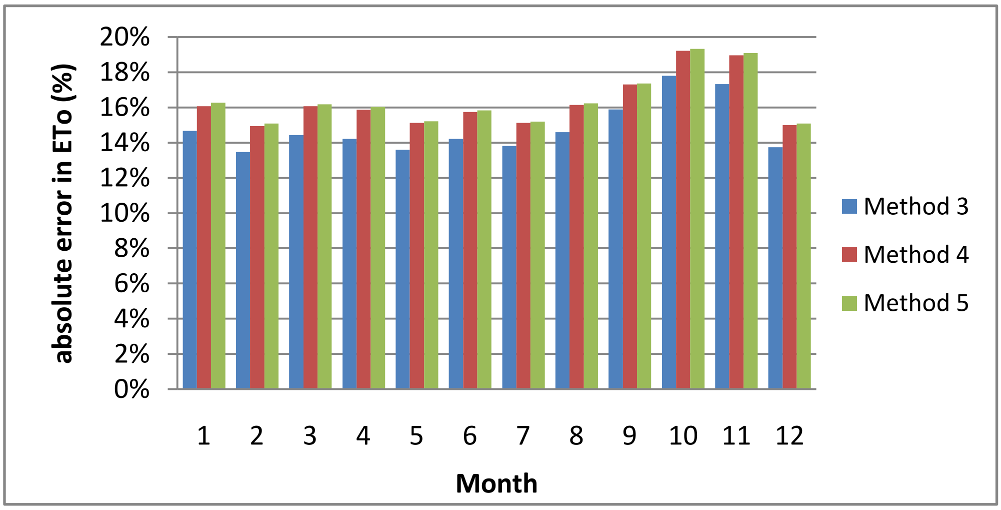


Figure 5.4: Methods 3, 4 and 5 - monthly errors for linear interpolation

The errors shown in figure 5.4 are also absolute errors. As can be seen, the errors of Method 4 are larger than the errors of Method 3 and the errors of Method 5 are even bigger. On average, the errors of Methods 3, 4 and 5 are smaller than the errors of Method 1. This means that of all the methods, Method 3 has the smallest errors in the ET_0. The errors are the biggest in October and November (like in Method 1), with 17.8% and 17.3% respectively for Method 3, 19.2% and 19.0% respectively for Method 4 and 19.3% and 19.1% respectively for Method 5.

The influence of $\hat{\alpha}$, $\hat{\beta}$, γ and Δ to the error in $ET_0$is also an interesting thing to look at in these three methods. Figures 5.5, 5.6 and 5.7 show the absolute errors due to $\hat{\alpha}$, $\hat{\beta}$, γ and Δ respectively. The error due to the error in a certain component is the error in ET_0 that occurs when the errors in all other components are set to zero.

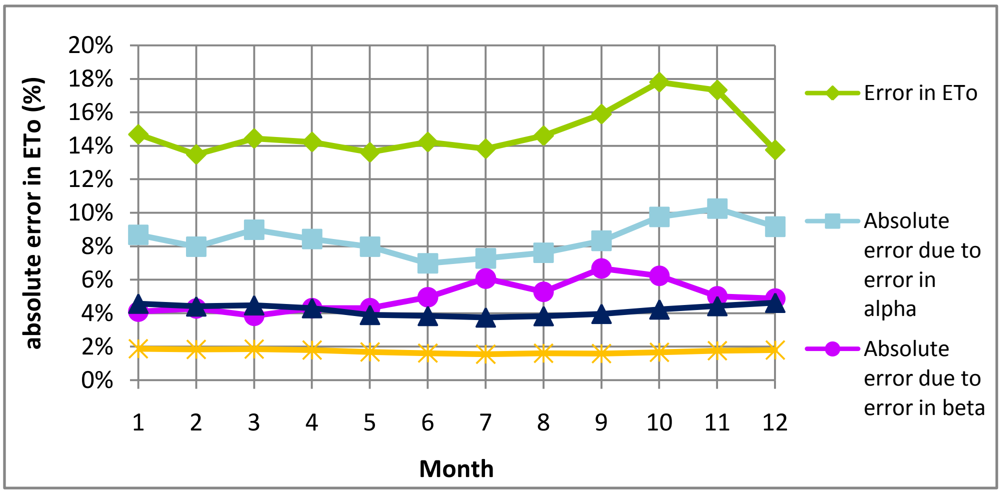


Figure 5.5: Method 3 (linear) - monthly errors due to alpha, beta, gamma and delta

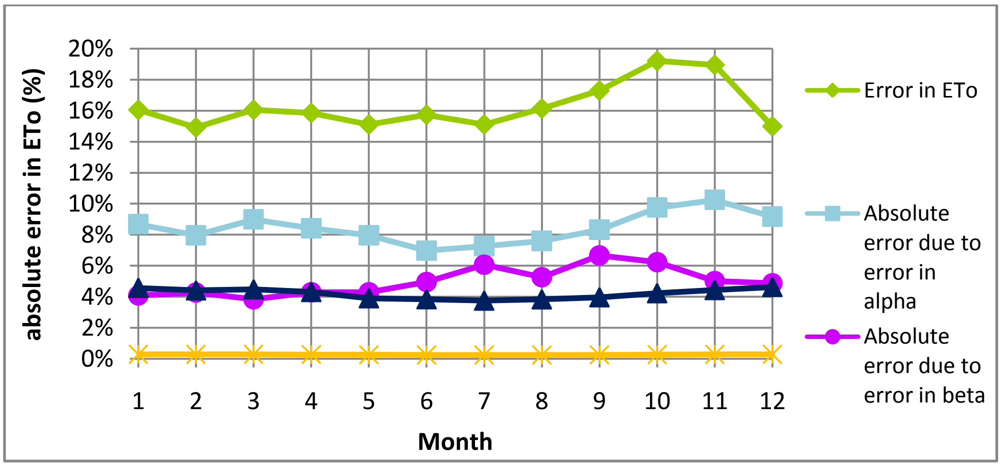


Figure 5.6: Method 4 (linear) - monthly errors due to alpha, beta, gamma and delta

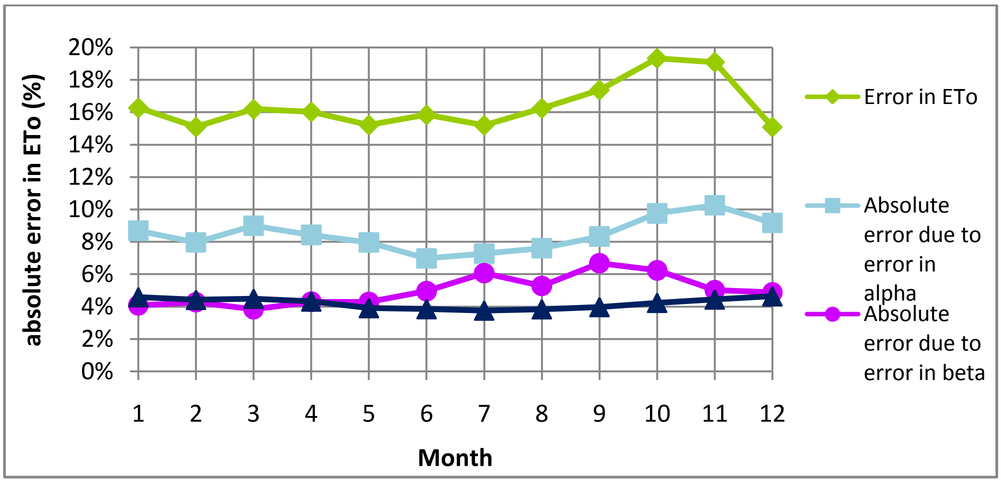


Figure 5.7: Method 5 (linear) - monthly errors due to alpha, beta and delta

As can be seen, the biggest part of the error in the $ET_o$is caused by errors in $\hat{\alpha}$. Also, only the errors due to $\hat{\alpha}$ and $\hat{\beta}$ seem to change significantly during the year. The error in gamma does not change during the year at all, because it only depends on the altitude in this model. The error in delta does not change much, because it depends on the temperature, which does not vary much during the year in Java. The error due to the error in gamma decreases from Method 3 to Method 4, but this makes the total error in the ET_o increase. This is because effect of the error in gamma to the value of the ET_o is positive when the effect of the errors in the other components to the value of the ET_o are negative and vice versa. When the error in gamma is taken away partially (in Method 4), the absolute error in ET_o increases. When the error in gamma is taken away entirely (in Method 5), the absolute error in ET_o increases even further. In Methods 4 and 5 however, the sum of absolute errors in the components is smaller.

5.1.2. Errors per station

Here the errors will be shown for every station not on the boundary (the stations marked with an orange circle or square in figure 3.1). The errors shown in this paragraph (5.1.2) are all averaged over the year. The errors per station for Method 1 with both linear triangle-based interpolation are shown in figure 5.8 below.

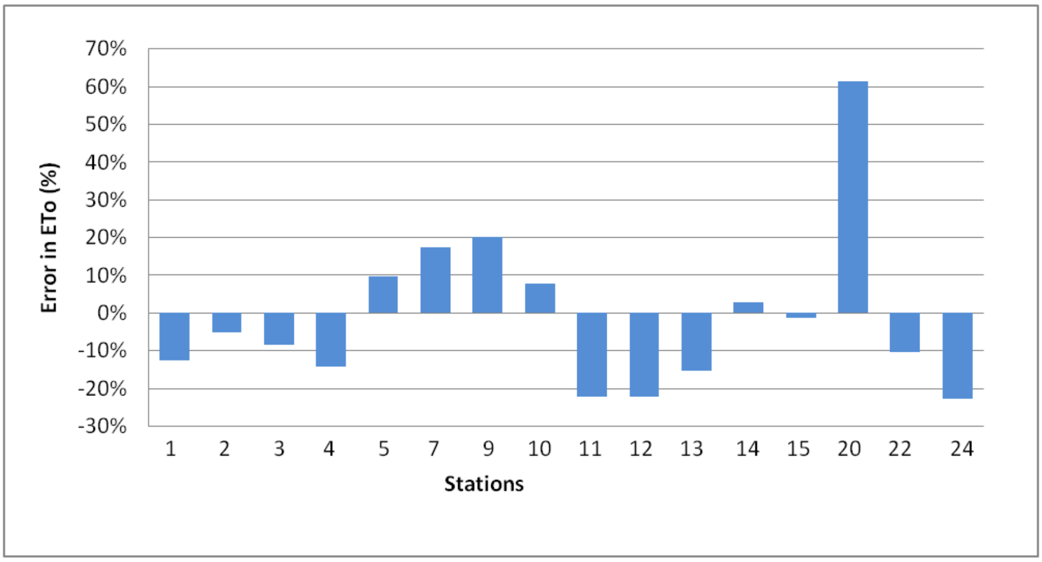


Figure 5.8: Method 1 - errors for each station averaged over the year for linear interpolation

As can be seen, station 20 (Tosari) has a very large error of 61.5%. Why this is will be discussed in section 5.2. Stations 14 (Sawahan) and 15 (Semarang) however show very small errors, 2.7% and -1.3% respectively.

The distribution of errors over the stations looks very different in Method 2. The errors per station for Method 2 with linear triangle-based interpolation are shown in figure 5.9 below.

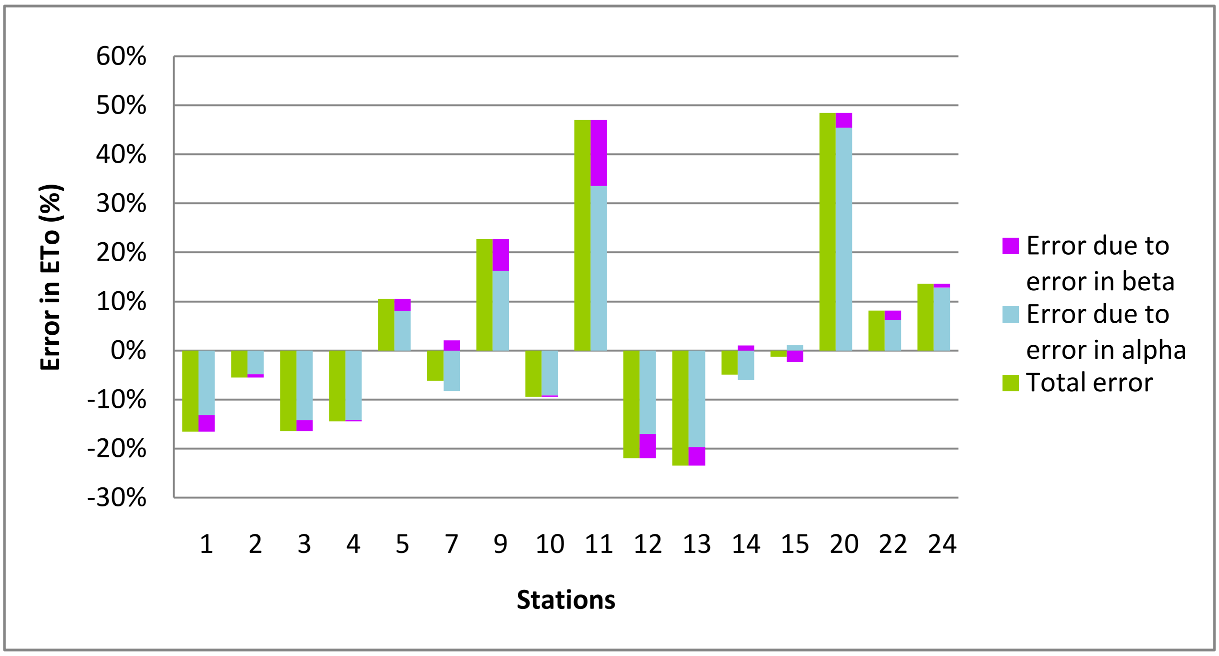


Figure 5.9: Method 2 - errors per station for linear interpolation

It can be seen that, like in Method 1, stations 14 (Sawahan) and 15 (Semarang) show very small errors and station 20 (Tosari) shows very high errors. In comparison with Method 1, stations 7, 10, 11, 14, 22 and 24 show a sign change. In this method, the error at station 11 (Pangerango) is also very high, why this is will also be discussed in section 5.2. The errors at stations 11 and 20 are 47.0% and 48.4% respectively. In the graphs the errors due to the errors in alpha and beta are also shown. For every station, except for station 15 where the total error is very small, the error due to alpha is much bigger than the error due to beta. The errors in alpha generate about 81% of the error in the ET_o.

The distribution of errors over the stations looks a bit different in Methods 3, 4 and 5. The errors per station for Methods 3, 4 and 5 are respectively shown in figures 5.10, 5.11 and 5.12 below.

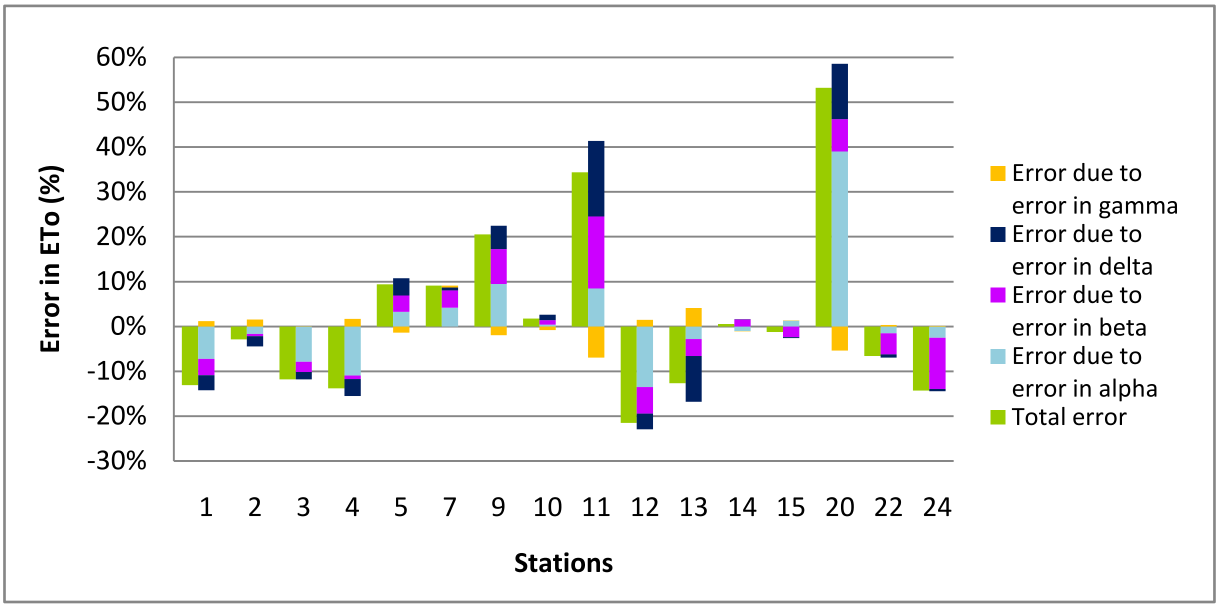


Figure 5.10: Method 3 - errors per station for linear interpolation

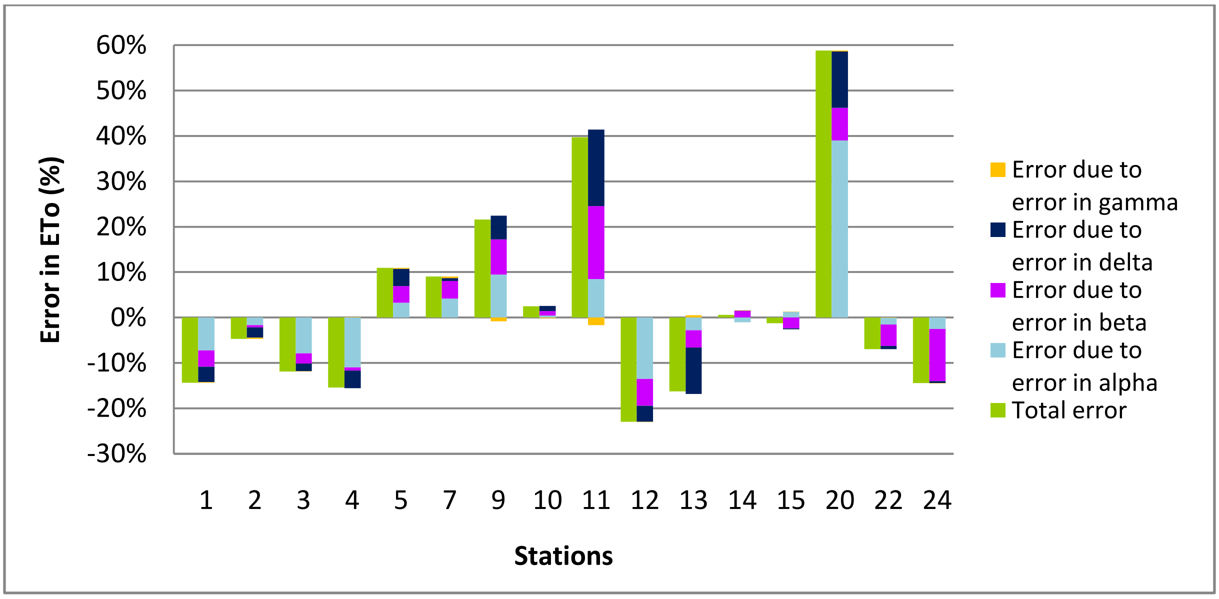


Figure 5.11: Method 4 - errors per station for linear interpolation

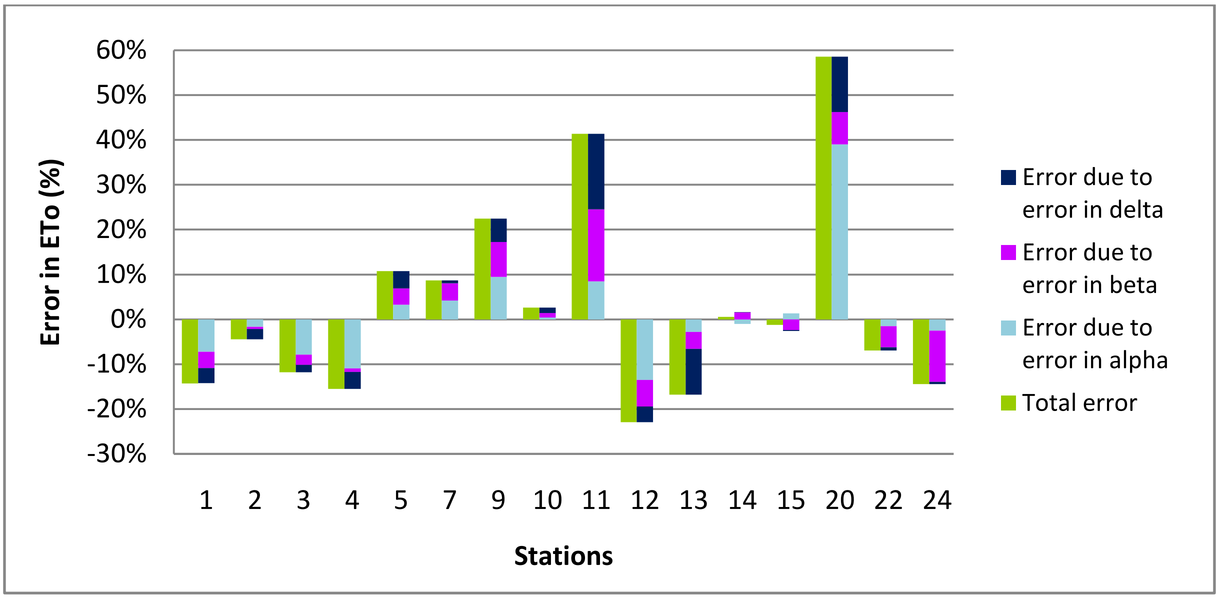


Figure 5.12: Method 5 - errors per station for linear interpolation

Again, stations 11 and 20 show very high errors. But most of the other stations show lower errors in these methods. ”. The errors at stations 11 and 20 are 34.4% and 53.2% respectively for Method 3, 39.7% and 58.8% respectively for Method 4 and 41.4% and 58.6% respectively for Method 5. In figure 5.10 can be seen that in Method 3, the error due to the error in gamma is often negative when all the other errors are positive and vice versa. This means that when the error due to gamma is reduced, as in Methods 4 and 5, the absolute error in the ET_o becomes higher. Table 5.1 below shows the share of alpha, beta, gamma and delta in the error of the ET_o in Methods 3, 4 and 5.

	error due to error in $\hat{\alpha}$	error due to error in $\hat{\beta}$	error due to error in γ	error due to error in Δ
Method 3	36.8%	33.5%	9.2%	20.5%
Method 4	39.4%	35.4%	1.8%	23.4%
Method 5	39.9%	36.0%	0.0%	24.1%

Table 5.1: The share of alpha, beta, gamma and delta in the error of the ET_o in Methods 3, 4 and 5

In all methods, the errors in $\hat{\alpha}$ cause the biggest part of the error in the ET_o. The errors in $\hat{\beta}$ also cause a big part of the error in the ET_o.

5.1.3. Average errors per method

In this paragraph will be looked at the average errors the different methods produce. The average errors of the different methods are shown in table 5.2 below.

Method 1		Method 2		Method 3	Method 4	Method 5
Linear	Cubic	Linear	Cubic	Linear	Linear	Linear
16.5%	17.8%	17.3%	18.1%	14.8%	16.3%	16.4%

Table 5.2: The average errors of the different modeling methods with the different interpolation methods

As can be seen, Method 3 is showing the best results. Method 2 actually has bigger average errors than Method 1, so the alpha and beta method is not better than just plain interpolation with the data used in this research. Methods 3, 4 and 5 are all better than Method 1.

In figures 5.8, 5.9, 5.10, 5.11 and 5.12 can be seen that the error in stations 11 and 20 is often much higher than the average error. This may mean the interpolation in these points makes not much sense with the used methods. A method can have a very low average error just because it makes the error in these bad points better, while it could at the same time create a worse result in the remaining points. Also, a method can have a very high average error just because it makes the error in the bad points worse, while it could at the same time create a better result in the remaining points. This means it makes sense to look at the average error of all stations except for 11 and 20. The average errors of the different method with exclusion of the errors in stations 11 and 20 are shown in table 5.3 below.

Method 1		Method 2		Method 3	Method 4	Method 5
Linear	Cubic	Linear	Cubic	Linear	Linear	Linear
12.3%	13.6%	13.0%	13.9%	10.5%	11.4%	11.5%

Table 5.3: The average errors of the different modeling methods with the different interpolation methods

As can be seen, the order in Methods, from good to bad, remains the same. It looks like it is just coincidence that Method 3 is better than Methods 4 and 5, which means it might be that Methods 4 and 5 are better when using other data sets, for instance with climatic data from different measurement stations or in a different research area.

5.1.4. Monthly variations

Here the monthly variations of alpha and beta for Method 2 and the monthly variations of $\hat{\alpha}$, $\hat{\beta}$, and Δ for Methods 3, 4 and 5 will be shown. This is interesting, because if the monthly variation is very low, an average interpolation over the year could be sufficient. When this is the case, the model can be made more simple. The values given in this paragraph are all calculated from only measurements, so no interpolation methods apply here.

In figure 5.13 below the monthly values of alpha are given for Method 2 for each station.

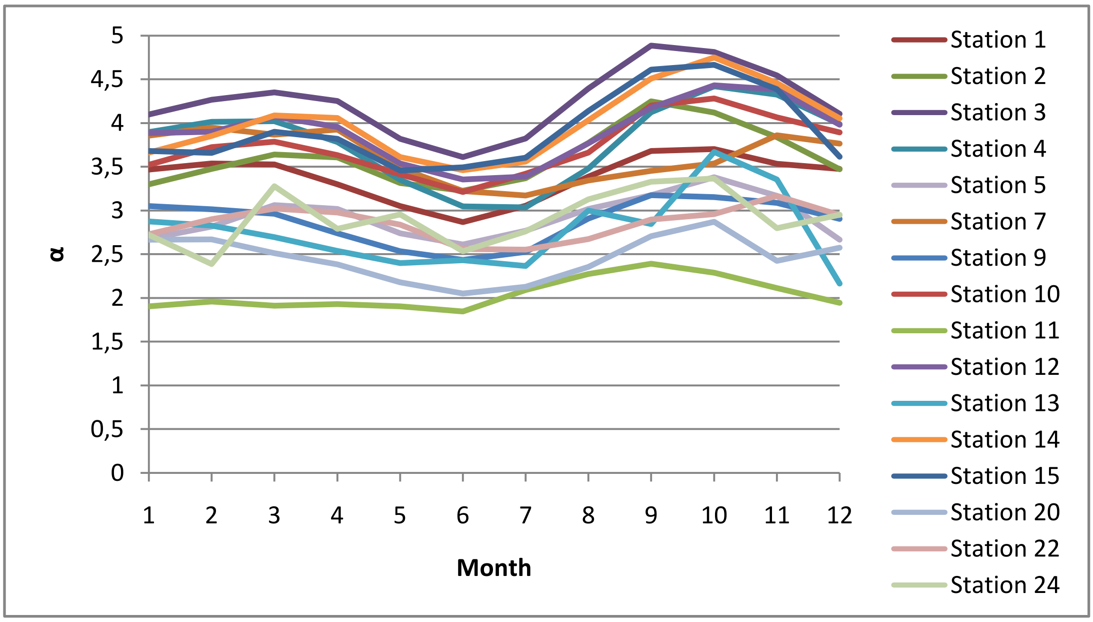


Figure 5.13: Method 2 - values of alpha for each station at each month

In figure 5.13 can be seen that the alpha fluctuates quite much during the year. On average (averaged per station), the maximum values are 15.8% bigger than the average values (averaged over the year). The minimum values are on average 14.4% smaller than the average values. This means the average difference between the minimum and the maximum value lies about 30.2% around the average, which is quite high. This is logical, because as can be seen in equation 4.3, alpha depends on R_n, which does not only depends on the temperature, but also on the daily sunshine hours and the number of the day in the year. The sunshine hours have a higher variation than the temperature.

In figure 5.14 below the monthly values of beta are given for Method 2 for each station.

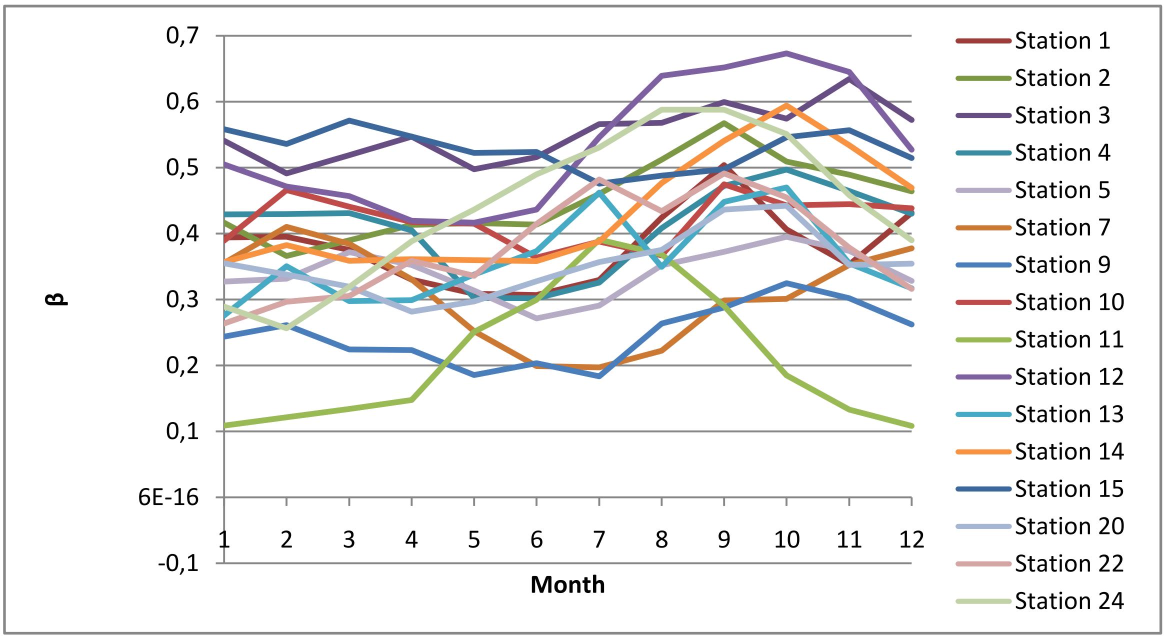


Figure 5.14: Method 2 - values of beta for each station at each month

In figure 5.14 can be seen that beta fluctuates even more than alpha during the year. On average, the maximum values are 29.1% bigger than the average values. The minimum values are on average 24.0% smaller than the average values. This means the average difference between the minimum and the maximum value lies about 53.1% around the average, which is very high. The relative differences are big, but the absolute differences are not very big, because beta has a very low value. The monthly variations are quite big because beta does not only depend on the temperature, but also on the relative humidity.

In figure 5.15 below the monthly values of $\hat{\alpha}$ are given for Methods 3, 4 and 5 for each station.

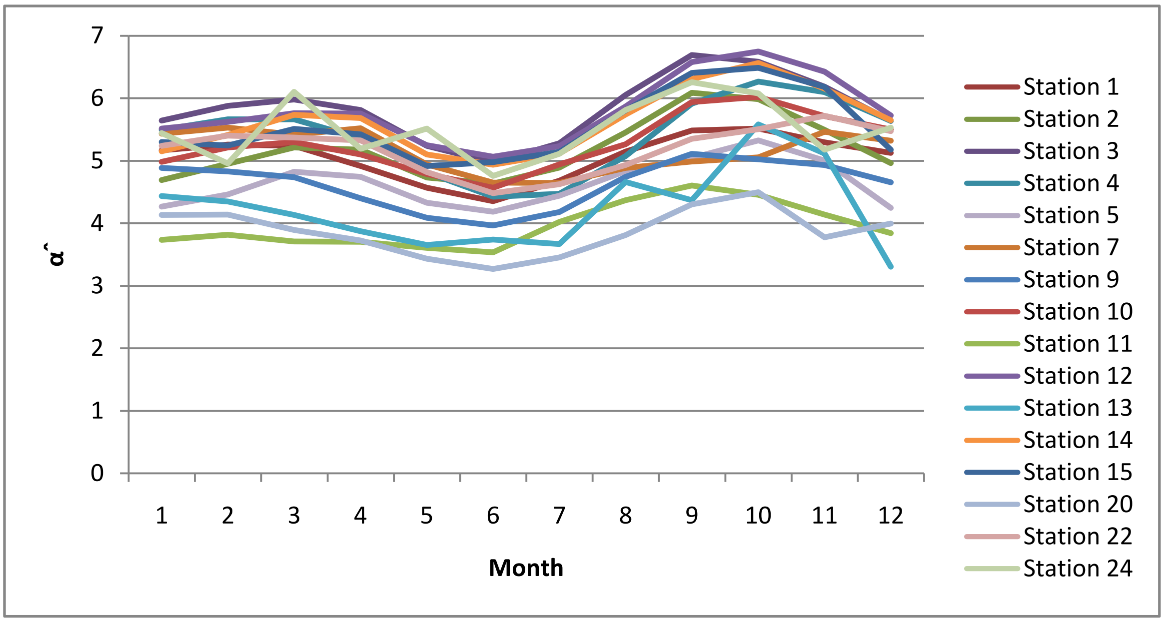


Figure 5.15: Methods 3, 4 and 5 - values of $\hat{\alpha}$ for each station at each month

As can be seen, $\hat{\alpha}$ fluctuates about as much as alpha did. On average, the maximum values are 15.1% bigger than the average values. The minimum values are on average 13.5% smaller than the average values. This means the average difference between the minimum and the maximum value lies about 28.6% around the average, which is again quite high. The monthly variations are a bit smaller, because $\hat{\alpha}$ does not at all depend on the wind speed (equation 4.7).

In figure 5.16 below the monthly values of $\hat{\beta}$ are given for Methods 3, 4 and 5 for each station.

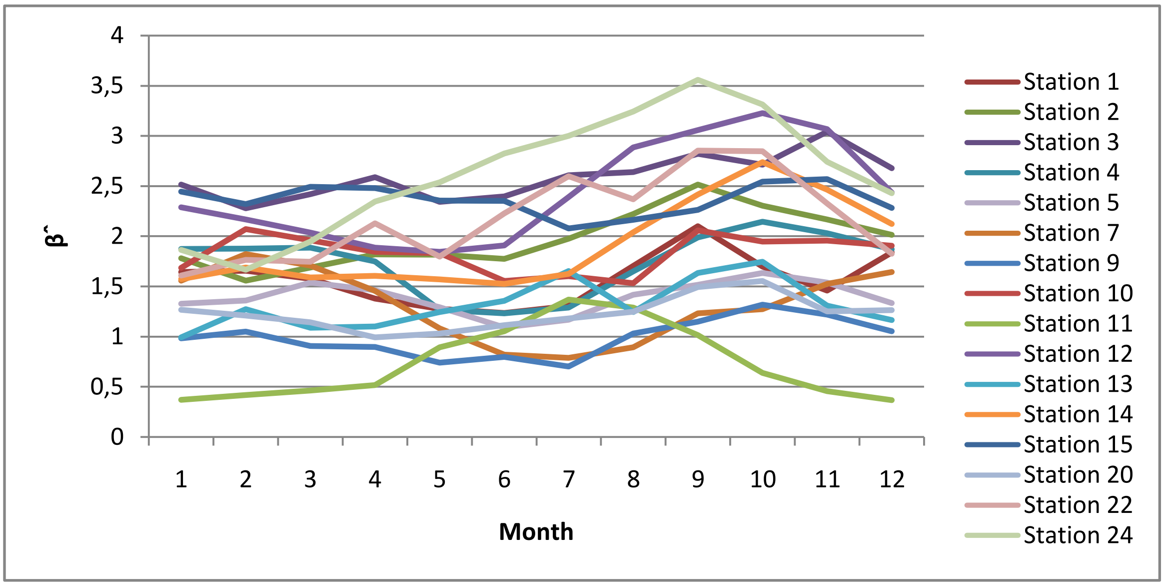


Figure 5.16: Methods 3, 4 and 5 - values of $\hat{\beta}$ for each station at each month

As can be seen, $\hat{\beta}$ also fluctuates about as much as beta did. On average, the maximum values are 31.3% bigger than the average values. The minimum values are on average 25.2% smaller than the average values. This means the average difference between the minimum and the maximum value lies about 56.5% around the average, which is again very high. The monthly variations are a bit larger, probably because the variations in the relative humidity and the temperature contributed more to the variation in beta than the variations in delta and the wind speed.

In figure 5.17 below the monthly values of Δ are given for Methods 3, 4 and 5 for each station.

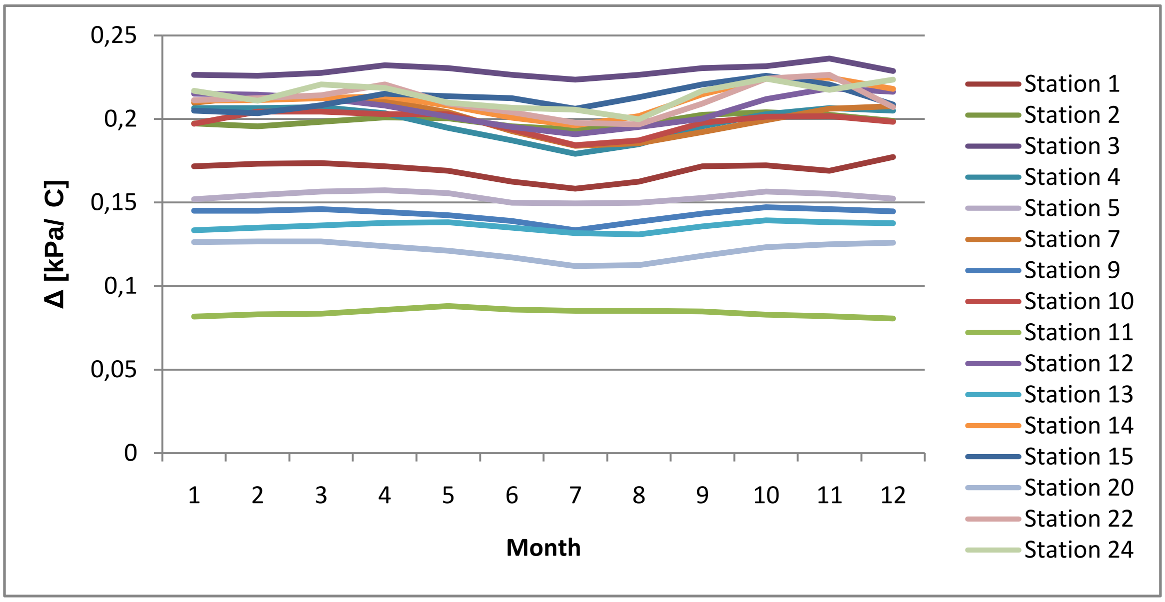


Figure 5.17: Methods 3, 4 and 5 - values of Δ for each station at each month

As can be seen, Δ does not fluctuate very much over the year. On average, the maximum values are only 4.5% bigger than the average values. The minimum values are on average only 5.9% smaller than the average values. This means the average difference between the minimum and the maximum value lies about 10.4% around the average, which is not very high. This means using only one surface where the average values over the year are used may be sufficient for Δ, as it will only create an error of about 5.2% in Δ on average. It is quite logical that the variation in Δ is very low, because (as can be seen in equation 2.9) it only depends on the temperature, which doesn't vary very much in Indonesia.

5.2. Discussion

In this section the phenomena seen in the results and the limitations of this study will be discussed. Based on this discussion, in the next chapter recommendations for improving the model and for further research will be given. The recommendations can be found in section 6.2.

The results showed that the error in the ET_O in Method 1 was smaller than in Method 2. This is most probably due to the fact that the error that is created by not (partially) excluding the wind speed from the interpolation in Method 1 actually makes the error in the predicted ET_O smaller. It could be that with a different research area or with data from different measurement stations the results of Method 2 are better than those of Method 1.

As can be seen in section 3.1, data was available for only 24 measurement stations and it looked like the wind data from the two different data suppliers was measured in a different way. Also, for some stations the measured wind speed was the same for the whole year, which may mean that only a rough estimate is given. The concept of the model relies on the dependency of the ET_O to the wind speed, so this probably did not influence the results in a good way. The amount of available measurement locations with the needed data was actually too little for a study area as big as whole Java. Retrieving more measurement data was too costly and took too much time for this research, but maybe this can be done in a following research.

In the previous section the results were discussed. It could be seen that the errors of the stations Pangerango and Tosari were very high. When looking at why this may be, we saw that these stations are both quite high up in the mountains, the station at Pangerango has an altitude of 3023m and the station at Tosari has an altitude of 1735m. In figures 5.10, 5.11 and 5.12 can be seen that the stations at Pangerango and Tosari both have a rather high error in the ET_O due to the error in delta. The equation used for calculating delta (equation 2.9) shows that delta only depends on one variable, the mean temperature. Of course high up in the mountains it is much colder than at sea level. Also, the stations at Pangerango and Tosari are very close to other stations with lower altitudes; Pangerango is very close to Rarahan which has an altitude of 1400 m and Tosari is very close to Pasuruan which has an altitude of only 5 m. This is most probably the origin of the big errors at stations 11 and 20, because the predicted values will be very close to the value at the closest station when stations 11 and 20 are used as control points. Also, around stations 11 and 20 there are multiple stations with a lower altitude compared to them, which also explains why the stations around 11 and 20 don't have such big errors.

As seen in the results, the total error in the ET_O in Method 4 was higher than in Method 3 and in Method 5 it was even higher. The goal of Method 4 was to make an improvement to Method 3, by calculating gamma in a better way. But the result of Method 4 was worse, because of "de-neutralization" of errors. This means that some errors cancelled each other out partially in Method 3 and this effect was reduced in Method 4. What was done is that actually an error that made the results better was partially taken away. In Method 5 the error due to gamma is even reduced to zero, by just using the given altitude instead of interpolation or an altitude from an altitude map and the result was worse than the result of Method 4. This means that a using method with a greater error in gamma (up to a certain level) actually creates a model with a better validation result. In section 7.2 will be explained why Method 3 is not really the best method to build up on, when an improvement is to be made to the model.

The results also showed that the value of delta does not vary very much over the year. It can be argued that for the sake of simplicity, only the average of delta over the year should be interpolated. The maximum that is created in delta that way is about 5.9%, this is not very much because an error of 5% in delta creates only an error of about 1% in the ET_o.

6. Conclusions and recommendations

6.1. Conclusions

The main goal of this research was to develop and apply a model for determining the reference crop evapotranspiration (ET_o) for Java spatially and temporally distributed. This had to be done by using different interpolation methods where the predicted wind speed is used as input. It can be said that this goal is achieved, because the model can determine the ET_o spatially distributed over Java and for each month. The last methods (Method 4 and 5), which entirely exclude the wind speed from the interpolation showed the best result, which shows that it makes sense to use the predicted wind speed as input for the model.

The results of this research showed that for the interpolation used in this model, linear triangle-based interpolation gives better results than cubic triangle-based interpolation. Cubic interpolation may look better, but it does not give more reliable results, because the smoothness is not based on anything physical.

The research also showed that plain interpolation is still better than the alpha and beta method. This is probably because errors cancel each other out in Method 1. This could be just coincidence, meaning that Method 2 could actually be better when using different data sets. However, Methods 3, 4 and 5 are better than plain interpolation. In Methods 3, 4 and 5, the wind speed is entirely excluded from the interpolation process. Of these three methods, Method 3 shows the best results, but this is due to the fact that errors cancel each other out here.

The research also showed that it is very hard to get enough and reliable data in Indonesia. This limited this research quite a bit, because with data from more stations the interpolation could have been carried out in more detail, which probably would have revealed more flaws and options of the model. As can be seen in figure 3.1, the locations of the measurement stations used in this research were quite clustered, so the model does not really give a good estimation of the ET_o over whole Java island. Retrieving more data has been tried during the course of this research, but with no success. Retrieving the data takes long, because the data is not stored digitally, so it needs to be prepared. Also, it is hard to find the people who actually have access to the data.

The model currently does not take into account the temperature decrease at high altitudes. This resulted in high errors at locations with low distance to neighboring stations as the crow flies, but with high altitude differences.

As can be seen in figure 5.3, in Method 2 alpha is the greatest cause of the errors. In figures 5.5, 5.6 and 5.7 can be seen that errors in $\hat{\alpha}$ are the greatest cause of the errors in the ET_o in Methods 3, 4 and 5. Errors in $\hat{\beta}$ and Δ also cause a moderate amount of the errors in the ET_o. Errors in γ on the other hand do not cause much of the errors in the ET_o. Should someone seek to improve the model, then searching for a solution to decrease the errors in the ET_o due to errors in $\hat{\alpha}$ would be a good thing to do at the start. A possible solution that could decrease the errors in $\hat{\alpha}$, $\hat{\beta}$ and Δ is presented in section 6.2.

6.2. Recommendations

In this section recommendations will be given for a possible following research.

The method with the best results was Method 3 in this research, but this does not mean this is the model that should be improved. The errors in the ET_o were only lower due to the fact that errors cancel each other out in this method (see the description below figures 5.10, 5.11 and 5.12). When improving the model, either the errors in Method 4 or Method 5 should be reduced, to be able to obtain the best results, because the sum of absolute errors in the components is lower in these methods. If it is realistic to include the altitude of the location in the input for the model for points not used in the interpolation, Method 5 should be used, otherwise Method 4 is better. This is realistic if it is easy and accurate to measure the altitude with a GPS device, for instance.

As said in section 6.1., the model currently does not take into account the temperature decrease when the altitude increases. The variables still creating much of the errors in the ET_o in Methods 4 and 5 are $\hat{\alpha}$, $\hat{\beta}$ and Δ. In equation 4.7 can be seen that $\hat{\alpha}$ depends on R_n and G. In equation 4.8 can be seen that $\hat{\beta}$ depends on T_{mean}, e_s and e_a. In equation 2.9 can be seen that Δ depends on T_{mean}. Figure 2.1 shows that R_n, G, e_s and e_a all depend on the temperature. This means that when the temperature is interpolated in a better way, the errors in $\hat{\alpha}$, $\hat{\beta}$ and Δ could all decrease. However, it is not an easy job to interpolate the temperature in such a way that it takes into account the altitude, because all known temperatures are all already measured at a certain altitude, so the difference between the altitude at the measurement locations and the altitude at the interpolation points should be taken into account. This means Δ can use the temperatures of some kind of temperature surface, because it is only directly related to the temperature. For $\hat{\alpha}$, R_n and G need to be substituted by their equations to make $\hat{\alpha}$ directly related to the temperature. Also, for $\hat{\beta}$, e_s and e_a need to be substituted by their equations to make $\hat{\beta}$ directly related to the temperature.

For a following research it is also recommended that first more data is obtained. Data of much more stations is needed to make the interpolation over whole Java island better. In figure 3.1 can be seen that the current measurement stations with available data do not cover whole Java island. Especially near the south coast more data from measurement stations is needed. What also can be done, is checking out if a standardization of the Penman-Monteith formula can be made for locations near the shoreline. Maybe certain conditions are always the same near the shoreline, which may mean that it is possible to make an equation for calculating the ET_o near the shoreline that only depends on the location of the point on the shoreline and not on any local meteorological measurements. If this is possible, then the shoreline can be used as a boundary and over whole Java the values for the ET_o can be obtained through interpolation.

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Appendices

Appendix I: List of symbols

Symbol	Description or formula
α	$\frac{0.408 \cdot \Delta(R_n - G)}{\Delta + \gamma(1 + 0.34 \cdot u_2)}$
$\hat{\alpha}$	$0.408(R_n - G)$
$\hat{\alpha}_{predicted}$	$\hat{\alpha}_{surface}(x_C, y_C, M)$
β	$\frac{\gamma \frac{900}{T_{mean} + 273}(e_s - e_a)}{\Delta + \gamma(1 + 0.34 \cdot u_2)}$
$\hat{\beta}$	$\frac{900}{T_{mean} + 273}(e_s - e_a)$
$\hat{\beta}_{predicted}$	$\hat{\beta}_{surface}(x_C, y_C, M)$
γ	psychometric constant [kPa °C^{-1}]
$\gamma(z(C))$	$0.665 \cdot 10^{-3} \cdot 101.3 \left(\frac{293 - 0.0065 \cdot z(C)}{293}\right)^{5.26}$
$\gamma_{predicted}$	$\gamma_{surface}(x_C, y_C)$
δ	solar decimation [rad]
Δ	slope of the relationship between the saturation vapor pressure and temperature [kPa °C^{-1}]
$\Delta_{predicted}$	$\Delta_{surface}(x_C, y_C, M)$
ε	ratio molecular weight of water vapour/dry air, 0.622 [-]
η	albedo or canopy reflection coefficient, 0.23 for the reference surface [-]
λ	latent heat of vaporization, 2.45 [MJ kg^{-1}]
λET	latent heat flux (representing the evapotranspiration) [MJ m^{-2} day^{-1}]
ρ_a	mean air density at constant pressure [kg m^{-3}]
σ	Stefan-Boltzmann constant, $4.903 \cdot 10^{-9}$ [MJ K^{-4} m^{-2} day^{-1}]
φ	latitude [rad]
ω_s	sunset hour angle [rad]
a_s	regression constant, expressing the fraction of extraterrestrial radiation reaching the earth on overcast days (n = 0)
$a_s + b_s$	fraction of extraterrestrial radiation reaching the earth on clear days (n = N)
b_s	additional regression constant, expressing the extra fraction of extraterrestrial radiation reaching the earth during sunshine hours
c_p	specific heat at constant pressure [MJ kg^{-1} °C^{-1}]
d	zero plane displacement height [m]
d_r	inverse relative distance Earth-Sun
e_a	actual vapor pressure [kPa]
e_s	saturation vapor pressure [kPa]
$(e_s - e_a)$	saturation vapor pressure deficit [kPa]
$e°(T)$	saturation vapour pressure at the air temperature T [kPa]
ET_o	reference evapotranspiration [mm day^{-1}]
G	soil heat flux density [MJ m^{-2} day^{-1}]
$G_{month,i}$	soil heat flux density in month i [MJ m^{-2} day^{-1}]
G_{sc}	solar constant, 0.0820 [MJ m^{-2} min^{-1}]

Symbol	Description or formula
J	number of the day in the year from 1 (1 January) to 365 or 366 (31 December)
k	von Karman's constant, 0.41 [-]
n	actual duration of sunshine [hour]
n/N	relative sunshine duration [-]
N	daylight hours [hour]
M	number of the month in the year from 1 (January) to 12 (December)
P	atmospheric pressure [kPa]
r_a	aerodynamic resistance [s m^{-1}]
r_s	(bulk) surface resistance [s m^{-1}]
R	specific gas constant, 0.287 [kJ kg^{-1} K^{-1}]
R_a	extraterrestrial radiation [MJ m^{-2} day^{-1}]
RH_{mean}	the mean relative humidity [-]
R_n	net radiation [MJ m^{-2} day^{-1}]
R_{nl}	net outgoing longwave radiation [MJ m^{-2} day^{-1}]
R_{ns}	net solar or shortwave radiation [MJ m^{-2} day^{-1}]
R_s	incoming solar or shortwave radiation [MJ m^{-2} day^{-1}]
R_s/R_{so}	relative shortwave radiation (limited to ≤ 1.0) [-]
R_{so}	clear-sky radiation [MJ m^{-2} day^{-1}]
T	the air temperature (measured at 2m height) [°C]
T_{max}	mean of the daily maximum temperatures taken over the month [°C]
$T_{max,K}$	maximum absolute temperature during the 24-hour period [K]
T_{mean}	the mean of the monthly averaged maximum and minimum temperatures (measured at 2m height) [°C]
T_{min}	mean of the daily minimum temperatures taken over the month [°C]
$T_{min,K}$	minimum absolute temperature during the 24-hour period [K]
$T_{month,i-1}$	the mean of the monthly averaged maximum and minimum temperatures in the previous month (measured at 2m height) [°C]
$T_{month,i+1}$	the mean of the monthly averaged maximum and minimum temperatures in the next month (measured at 2m height) [°C]
u_2	wind speed at 2 m height [m s^{-1}]
u_z	wind speed at height z [m s^{-1}]
z	elevation above sea level [m]
z_h	height of humidity measurements [m]
z_m	height of wind measurements [m]
z_{oh}	roughness length governing transfer of heat and vapour [m]
z_{om}	roughness length governing momentum transfer [m]

Table A-I.1: A list of all symbols used in this document and their description or formula

Appendix II: MatLab Model

Appendix II.a: Overview

In the following two schedules an overview is given of the model as implemented in MatLab. In these two schedules all 5 modeling methods are shown.

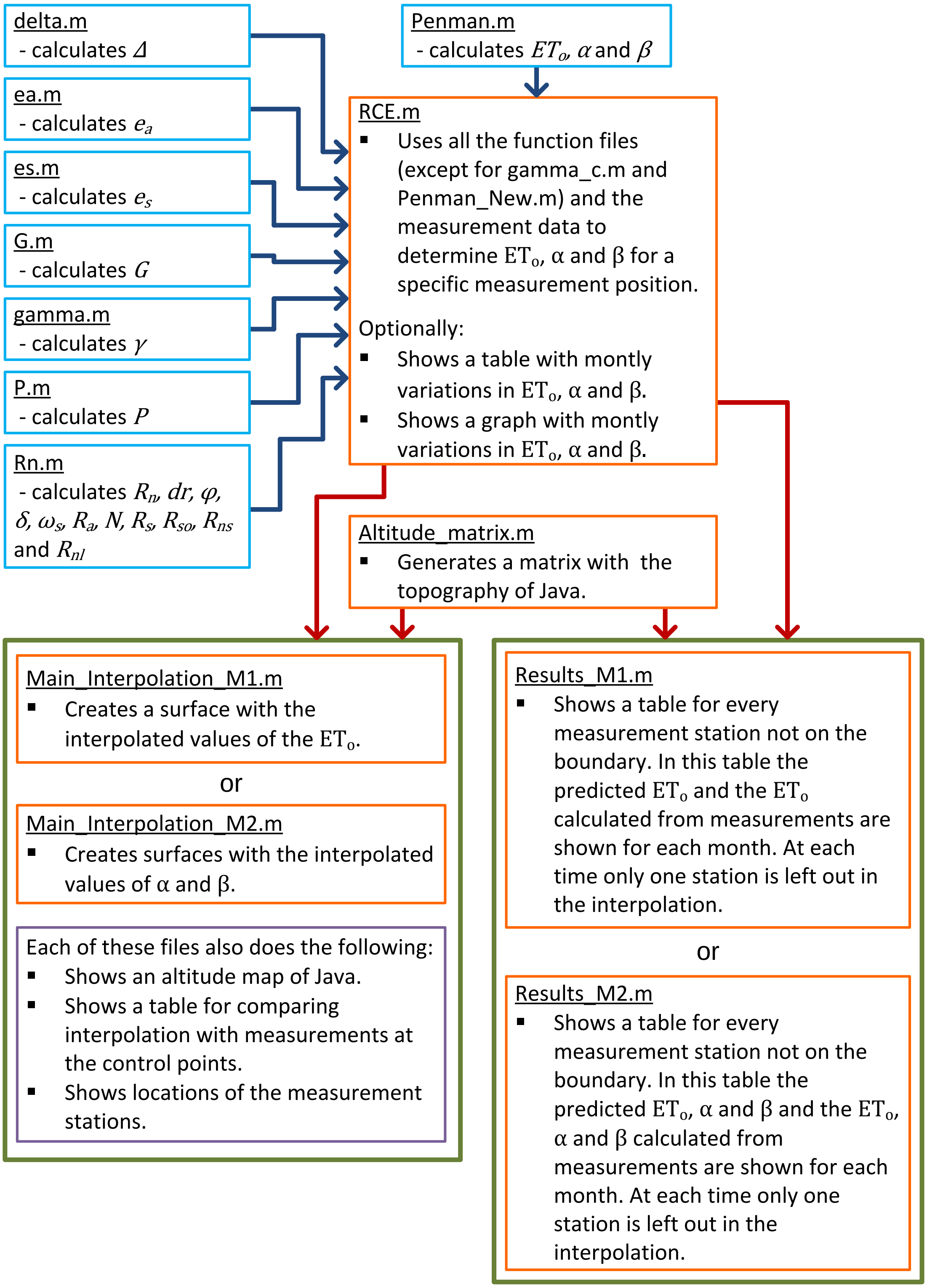

Figure A-II.1: Flowchart for Methods 1 and 2 in MatLab

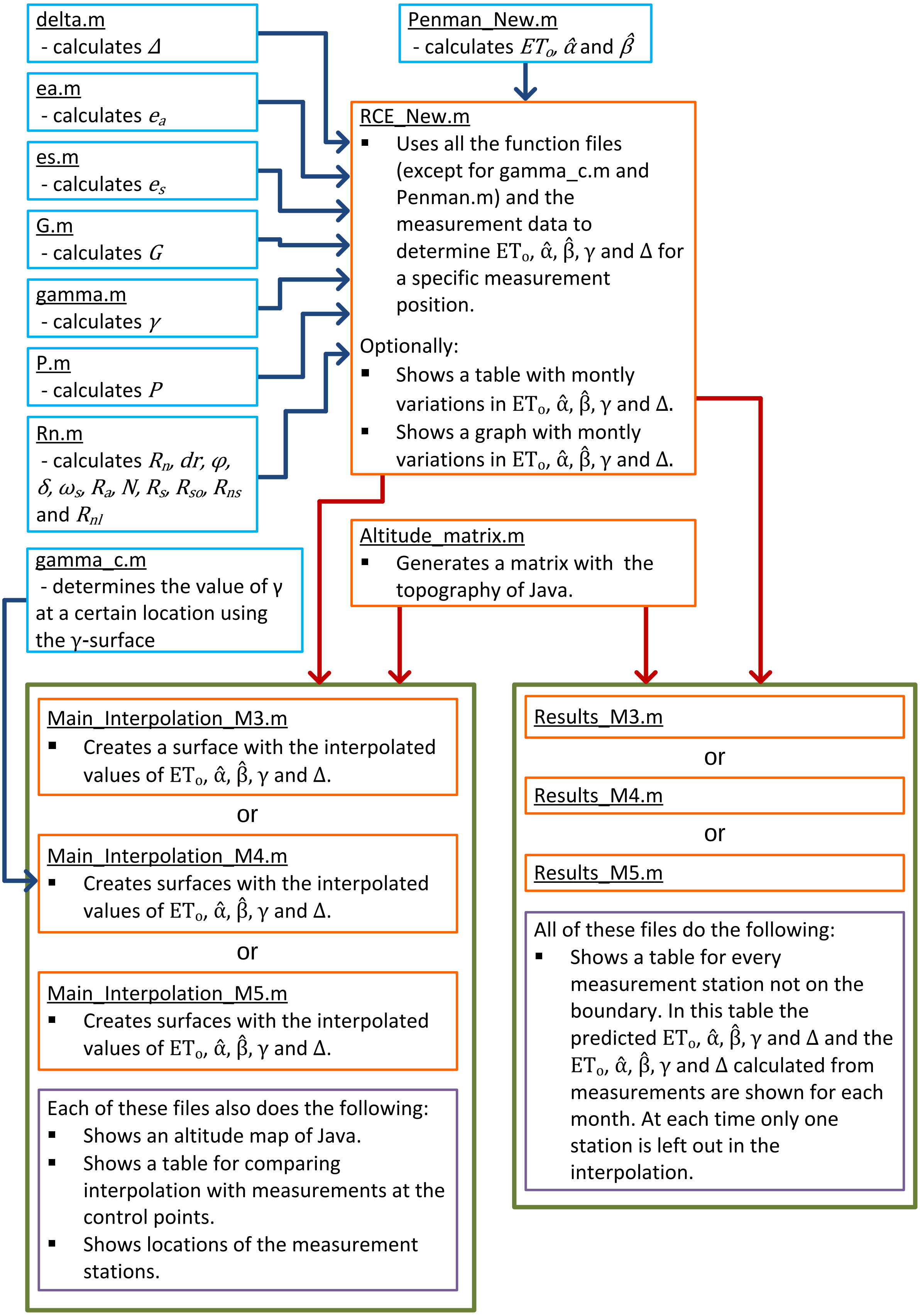

Figure A-II.2: Flowchart for Methods 3, 4 and 5 in MatLab

Each orange and blue box stands for a different MatLab-file. Blue boxes represent function files and orange boxes represent script files. A blue arrow means a function is called from within the script the arrow points at. A red arrow means a script is run by the script the arrow points at.

Basically the executable scripts named 'RCE.m' and 'RCE_New.m' handle with a lot of the functions to calculate ET_o, α and β and ET_o, $\hat{\alpha}$, $\hat{\beta}$, γ and Δ respectively. The model input that is also needed in 'RCE.m' and 'RCE_New.m' is supplied by the executable script called 'Main_Interpolation_M#.m', where # can be replaced by the number of the method. 'RCE.m' is used for methods 1 and 2, while 'RCE_New.m' is used for methods 3, 4 and 5. 'Main_Interpolation_M#.m' loads the model input from text documents (*.txt) and saves it in a matrix named 'M'. Each measurement station has a text document with its measurement data in it. The script then forces the 'RCE.m' or 'RCE_New.m' script to run and uses the output it supplies to do interpolations and calculations. The script 'Main_Interpolation_M#.m' also forces the script 'Altitude_Matrix.m' to run. The latter script loads topography data for Java from a text document named 'Jawa_30sec_NewLocation2.txt', this data is converted into a matrix with the data of the land topography of Java which is used in 'Main_Interpolation_M#.m'. 'Main_Interpolation_M#.m' then shows the relevant surface plots for method #, along with a table showing the relevant values for the control points. There are also some scripts called 'Results_M#.m', where again # can be replaced by the number of the method. These scripts perform the same calculations as 'Main_Interpolation_M#.m' but show no graphs. They do show a long list of tables in MatLab's command window, one table for each station that can be a control point. Each table shows the relevant values for each month for a certain station that is taken as control point.

Appendix II.b: Function files

The input and output of the different function files and where the output of the functions is used is listed in table A-II.1 below.

Function file	Input	Output	Output used in
delta.m	T	Δ	Penman.m, Penman_New.m
ea.m	$T_{min}, T_{max}, RH_{mean}$	e_a	Rn.m, Penman.m, Penman_New.
es.m	T_{max}, T_{min}	e_s	Penman.m, Penman_New.m
G.m	$T_{month,i+1}, T_{month,i-1}$	G	Penman.m, Penman_New.m
gamma.m	$P, c_p, \lambda, \varepsilon$	γ	Penman.m, Penman_New.m
P.m	z	P	gamma.m
Rn.m	η, a_s, b_s, n, J, latitude*, σ, $T_{max,K}, T_{min,K}, e_a, z, G_{sc}$	$R_n, d_r, \varphi, \delta, \omega_s, R_a$, $N, R_s, R_{so}, R_{ns}, R_{nl}$	Penman.m**, Penman_New.m**
Penman.m	$\Delta, R_n, G, e_s, e_a, \gamma, T, u_2$	ET_o, α, β	Main_Interpolation_M1.m, Main_Interpolation_M2.m, Results_M1.m, Results_M2.m
Penman_New.m	$\Delta, R_n, G, e_s, e_a, \gamma, T, u_2$	$ET_o, \hat{\alpha}, \hat{\beta}$	Main_Interpolation_M3.m, Main_Interpolation_M4.m, Main_Interpolation_M5.m, Results_M3.m, Results_M4.m, Results_M5.m
gamma_c.m	latitude*, longitude*, γ-surface, altitude matrix of Java	γ at the location, the altitude used to determine that γ	Main_Interpolation_M4.m, Results_M4.m

Table A-II.1: Overview of the function files in the MatLab model

*: Latitude and longitude in decimal degrees.

**: Actually only the value of R_n is used in Penman.m and Penman_New.m, the rest of the output is given only to be able to check it.

Appendix II.c: Script files

RCE.m

This is a script file for determining the ET_o, α and β at the measurement positions. It is used by 'Main_Interpolation_M1.m', 'Main_Interpolation_M2.m', 'Results_M1.m' and 'Results_M2.m' but can also be used individually.

Input

- A text document for the weather station, containing the following:
  - T_{max}: The mean maximum temperature for each month
  - T_{min}: The mean minimum temperature for each month
  - The latitude and longitude of the measurement location
  - z: The elevation of the ground above sea level on the measurement location
  - n: The mean actual daily sunshine hours for each month
  - RH_{mean}: The mean relative air humidity for each month
  - u_2: The wind speed for each month (measured at 2m height)
- This script file makes use of the following function files:
  - delta.m
  - ea.m
  - es.m
  - G.m
  - gamma.m
  - P.m
  - Rn.m
  - Penman.m

Output

- $ET_o(m)$: The calculated values for the reference crop evapotranspiration of every month 'm' at a specific measurement station.
- $\alpha(m)$: The calculated values for α of every month 'm' at a specific measurement station.
- $\beta(m)$: The calculated values for β of every month 'm' at a specific measurement station.

- Optionally:
  - a table with monthly values of ET_o, α and β
  - a plot with monthly values of ET_o, α and β

Options

In this script file the user can choose to show a table and/or a graph with the monthly values for the ET_o, α and β. This can be done by changing the following:

- 'show_table', When this value is set to 1, a table will be shown in the command window with monthly values of ET_o, α and β.
- 'show_plot', When this value is set to 1, a plot will be shown in a new figure with monthly values of ET_o, α and β.

The user must make sure the values for these options are set to 0 before running 'Main_Interpolation_M1.m', 'Main_Interpolation_M2.m', 'Results_M1.m' or 'Results_M2.m'. When this is not done, the 'RCE.m' script will create a table and/or a graph with monthly values for the ET_o, α and β for each station specified in those scripts.

To run this script file individually, the user has to specify the matrix 'M' with input data for this script. For this a text document needs to be loaded into 'M'. The format of the text documents with the input data will be described later in this chapter.

To run this file only for one station, the user must do the following:

1. The user must go to the command window and then type:
   >> M = load('{name}.txt')
   where {name} is the name of the station (entered without curly brackets).
2. After that, the user must enter the following line in the command window:
   >> run RCE
   Make sure the current directory is set to the directory with 'RCE.m' in it.
   Instead of this last step, the user can also go to the Editor and run RCE there.

RCE New.m

This is a script file for determining the ET_o, $\hat{\alpha}$, $\hat{\beta}$, γ and Δ at the measurement positions. It is used by 'Main_Interpolation_M3.m', 'Main_Interpolation_M4.m', 'Main_Interpolation_M5.m', 'Results_M3.m', 'Results_M4.m' and 'Results_M5.m' but it can also be used individually.

Input

- A text document for the weather station, containing the following:
  - T_{max}: The mean maximum temperature for each month
  - T_{min}: The mean minimum temperature for each month
  - The latitude and longitude of the measurement location
  - z: The elevation of the ground above sea level on the measurement location
  - n: The mean actual daily sunshine hours for each month
  - RH_{mean}: The mean relative air humidity for each month
  - u_2: The wind speed for each month (measured at 2m height)
- This script file makes use of the following function files:
  - delta.m
  - ea.m
  - es.m
  - G.m
  - gamma.m
  - P.m
  - Rn.m
  - Penman_New.m

Output

- $ET_o(m)$: The calculated values for the reference crop evapotranspiration of every month 'm' at a specific measurement station.
- $\hat{\alpha}(m)$: The calculated values for $\hat{\alpha}$ of every month 'm' at a specific measurement station.
- $\hat{\beta}(m)$: The calculated values for $\hat{\beta}$ of every month 'm' at a specific measurement station.
- $\gamma(m)$: The calculated values for γ of every month 'm' at a specific measurement station.
- $\Delta(m)$: The calculated values for Δ of every month 'm' at a specific measurement station.

- Optionally:
  - a table with monthly values of ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ.
  - a plot with monthly values of ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ.

Options
In this script file the user can choose to show a table and/or a graph with the monthly values for the ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ $and \Delta$. This can be done by changing the following:

- 'show_table', When this value is set to 1, a table will be shown in the command window with monthly values of ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ $and \Delta$.
- 'show_plot', When this value is set to 1, a plot will be shown in a new figure with monthly values of $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ.

The user must make sure the values for these options are set to 0 before running 'Main_Interpolation_M3.m', 'Main_Interpolation_M4.m', 'Main_Interpolation_M5.m', 'Results_M3.m', 'Results_M4.m' or 'Results_M5.m'. When this is not done, the 'RCE_New.m' script will create a table and/or a graph with monthly values for the ET_o, $\hat{\alpha}$, $\hat{\beta}$, γ *and* Δ for each station specified in those scripts.

To run this script file individually, the user has to specify the matrix 'M' with input data for this script. For this a text document needs to be loaded into 'M'. The format of the text documents with the input data will be described later in this chapter.
To run this file only for one station, the user must do the following:
1. The user must go to the command window and then type:
>> M = load('{name}.txt')
where {name} is the name of the station (entered without curly brackets).
2. After that, the user must enter the following line in the command window:
>> run RCE_New
Make sure the current directory is set to the directory with 'RCE_New.m' in it.
Instead of this last step, the user can also go to the Editor and run RCE_New there.

Altitude_Matrix.m

This is a script file for generating a matrix with altitudes of the land of Java. It is used in 'Main_Interpolation_M#.m', where # can be replaced by any number from 1 to 5. It imports data from the file 'Jawa_30sec_NewLocation2.txt'.

Input
- Jawa_30sec_NewLocation2.txt'

Output
- 'Java_land': A matrix with the altitudes of the land of Java.
- Optionally: A graph showing the topography of the land of Java.

Options
In this script file the user can choose to show a graph with the topography of the land of Java. This can be done by changing the following:

- 'plot_topo', When this value is set to one, a plot will be shown in a new figure with the topography of the land of Java.

This script can be run individually without any adaptations.

Main_Interpolation_M#.m

This is a script file for creating surface plots of the interpolations. 'Main_Interpolation_M1.m' creates a surface plot of ET_o. 'Main_Interpolation_M2.m' creates surface plots of α and β. 'Main_Interpolation_M3.m' and 'Main_Interpolation_M4.m' create surface plots of $\hat{\alpha}$, $\hat{\beta}$, γ *and* Δ. 'Main_Interpolation_M5.m' creates surface plots of $\hat{\alpha}$, $\hat{\beta}$ *and* Δ. Also always a surface plot of ET_o will be shown with a flat version of the topography beneath it. In these surface plots the positions of the different stations are visible. A surface plot of the topography of Java is also shown. This script file uses output of the script files 'Altitude_matrix.m' and 'RCE.m' or 'RCE_New.m' and also forces these scripts to run.

In making the interpolations, the user can choose to leave a few weatherstations out. This means that they will be left out in the interpolation process and they will be marked with a star in the surface plot.
For the stations that are left out, the relevant values calculated from measurements will be shown as well as the values calculated by using interpolation.

Input
For all methods:
- $ET_o(m)$: The calculated values for the reference crop evapotranspiration of every month 'm' at a specific measurement station.
- 'Java_land': A matrix with the altitudes of the land of Java.
- This script file runs the following script files to get the input:
  - Altitude_matrix.m

For M1:
- This script file runs the following script files to get the input:
  - RCE.m

For M2:
- $\alpha(m)$: The calculated values for alpha of every month 'm' at a specific measurement station.
- $\beta(m)$: The calculated values for beta of every month 'm' at a specific measurement station.
- This script file runs the following script files to get the input:
  - RCE.m

For M3:
- $\hat{\alpha}(m)$: The calculated values for $\hat{\alpha}$ of every month 'm' at a specific measurement station.
- $\hat{\beta}(m)$: The calculated values for $\hat{\beta}$ of every month 'm' at a specific measurement station.
- $\gamma(m)$: The calculated values for γ of every month 'm' at a specific measurement station.
- $\Delta(m)$: The calculated values for Δ of every month 'm' at a specific measurement station.
- This script file runs the following script files to get the input:
  - RCE_New.m

For M4:
- $\hat{\alpha}(m)$: The calculated values for $\hat{\alpha}$ of every month 'm' at a specific measurement station.
- $\hat{\beta}(m)$: The calculated values for $\hat{\beta}$ of every month 'm' at a specific measurement station.
- $\Delta(m)$: The calculated values for Δ of every month 'm' at a specific measurement station.
- This script file runs the following script files to get the input:
  - RCE_New.m
- This script file makes use of the following function file:
  - gamma_c.m

For M5:
- $\hat{\alpha}(m)$: The calculated values for $\hat{\alpha}$ of every month 'm' at a specific measurement station.
- $\hat{\beta}(m)$: The calculated values for $\hat{\beta}$ of every month 'm' at a specific measurement station.
- $\Delta(m)$: The calculated values for Δ of every month 'm' at a specific measurement station.

- This script file runs the following script files to get the input:
  - RCE_New.m

Output
For all methods:
- All surface plots include the following:
  - The locations of all the weather stations. Where weather stations that are left out are marked with a star instead of a triangle.
  - A list of the weather stations, where the stations that are left out are marked red.
- The surface plot showing the interpolated values of ET_o also shows the following:
  - An altitude map of Java.
  - A table showing the relevant values calculated from measurements as well as the values calculated by using interpolation for the stations that are left out.

For M1:
- A surface plot showing the interpolated values of ET_o.

For M2:
- A surface plot showing the interpolated values of ET_o.
- A surface plot showing the interpolated values of α.
- A surface plot showing the interpolated values of β.

For M3 and M4:
- A surface plot showing the interpolated values of ET_o.
- A surface plot showing the interpolated values of $\hat{\alpha}$.
- A surface plot showing the interpolated values of $\hat{\beta}$.
- A surface plot showing the interpolated values of γ.
- A surface plot showing the interpolated values of Δ.

For M5:
- A surface plot showing the interpolated values of ET_o.
- A surface plot showing the interpolated values of $\hat{\alpha}$.
- A surface plot showing the interpolated values of $\hat{\beta}$.
- A surface plot showing the interpolated values of Δ.

Options
In this script the user can choose for what month the interpolation should be made. The user can also specify the names of the stations. When doing this, the user must make sure a text document with the data for that station in it is provided with as document name the same name as the name of the station. The user can also specify which weather stations should be used as control data. The size of one rectangle in the interpolation can also be specified, in both the latitude and the longitude direction. The user can also choose which interpolation method will be used. This can all be done by changing the following:

- 'Month', The month for which the output is wanted is specified here. When the user sets the month to 13, the average over the year is calculated.
- 'stations', The names of the stations are assigned here. These names should be the same as the names of the text documents with the data of the stations in it. The names are assigned in an array, where the different names are separated by a comma.
- 'leave_out', Here the user can assign which stations are used as control points. '[]' means

no stations are used as control points. If you want certain stations to be control points, add their number between the brackets. For more than one station, separate the different numbers with a space. The number of the station is the column number of the station in the variable 'stations'.

- 'method', Here the user can choose which interpolation method should be used. There are four methods that can be used here:
  - 'linear' Triangle-based linear interpolation
  - 'cubic' Triangle-based cubic interpolation
  - 'nearest' Nearest neighbor interpolation
  - 'v4' MATLAB 4 griddata method

  It is recommended to use linear interpolation.
- 'dx', Changing the value for 'dx' below changes the size of one rectangle in the longitude direction.
- 'dy', Changing the value for 'dy' changes the size of one rectangle in the latitude direction.

Results_M#.m

This is a script file for creating numerical results in a fast way. It does the same calculations as 'Main_Interpolation_M#.m', but it does not show interpolation surfaces. It calculates the same output as 'Main_Interpolation_M#.m', but for all months and for all stations not on the boundary, where one station is used as control point at any one time.

Input

The same input as the input for 'Main_Interpolation_M#.m'.

Output

For M1:

- Tables showing the interpolated values of ET_o and the values of ET_o as calculated from measurements. Each table shows these values for one measurement station used as control point.

For M2:

- Tables showing the interpolated values of α and β , the value of ETo as calculated from the interpolated α and β and the measured wind speed and the values of ET_o, α and β as calculated from measurements. Each table shows these values for one measurement station used as control point.

For M3 and M4:

- Tables showing the interpolated values of $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ , the value of ETo as calculated from the interpolated $\hat{\alpha}, \hat{\beta}, \gamma$ *and* Δ and the measured wind speed and the values of ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ as calculated from measurements. Each table shows these values for one measurement station used as control point.

For M5:

- Tables showing the interpolated values of $\hat{\alpha}, \hat{\beta}$ and Δ , the value of ETo as calculated from the interpolated $\hat{\alpha}, \hat{\beta}$ *and* Δ, the measured wind speed and the γ as calculated from measurements and the values of ET_o, $\hat{\alpha}, \hat{\beta}, \gamma$ and Δ as calculated from measurements. Each table shows these values for one measurement station used as control point.

Options

The same options as 'Main_Interpolation_M#.m', except for the fact that 'Month' and 'leave_out' are defined in another way here. The calculation is done for all months and all stations that can be left out individually, so these two options don't apply here.

Appendix II.d: Input file format

Shown in table A-II.2 is the file format of an input file with weather data from a specific measurement position. The red areas in the schedule are only to indicate at which column and row in the file the data are supposed to be given.

The first row contains the values for the latitude, the longitude and the altitude, so the first row indicates the location of the measurement position. The 5 other columns of this row have value 0, just so MatLab can load it, because then all rows should have the same amount of columns.

The next 12 rows contain the data for each month. In the first column the number of the month is given. In the second and third columns T_{max} and T_{min} respectively for that month are given. In the fourth, fifth and sixth column RH_{mean}, u_2 and n for that month respectively are given. The seventh and eighth column only have data when it's supplied by the program CropWat, this is a program for showing FAO data (FAO, 2009). This data is not used in the model but can be used for comparison. When this CropWat data is available for the specific weather station, the seventh and eighth column will show the R_n and ET_o as calculated in CropWat respectively. When this data is not available all values for these columns are set to 0. The last row contains averages of all the months, these are not used in the model.

Rows	Columns: 1	2	3	4	5	6	7	8
1	Latitude	Longitude	Altitude	0	0	0	0	0
2	1	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
3	2	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
4	3	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
5	4	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
6	5	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
7	6	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
8	7	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
9	8	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
10	9	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
11	10	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
12	11	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
13	12	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o
14	0	T_{max}	T_{min}	RH_{mean}	u_2	n	CropWat R_n	Cropwat ET_o

Table A-II.2: The file format of an input file

The dimensions of the input values are as follows:

- Latitude: degrees.minutes (e.g. -6° 12' → -6.12)
- Longitude: degrees.minutes (e.g. 138° 54' → 138.54)
- Altitude: [m]
- T_{max}: [°C]
- T_{min}: [°C]
- RH_{mean}: [%]
- u_2: [km day^{-1}]
- n: [hours]
- CropWat R_n: [MJ m^{-2} day^{-1}]
- Cropwat ET_o: [mm day^{-1}]

Appendix III: Code of the MatLab m-files

Appendix III.a: Function files

delta.m

```
function delta = delta(T)

delta = (4098*(0.6108*exp((17.27*T)/(T+237.3))))/((T+237.3)^2);

end
```

ea.m

```
function ea = ea(Tmin,Tmax,RH)

eTmin = 0.6108 * exp((17.27*Tmin)/(Tmin+237.3));

eTmax = 0.6108 * exp((17.27*Tmax)/(Tmax+237.3));

ea = (RH/100)*((eTmax+eTmin)/2);

end
```

es.m

```
function es = es(Tmax,Tmin)

eTmax = 0.6108 * exp((17.27*Tmax)/(Tmax+237.3));
eTmin = 0.6108 * exp((17.27*Tmin)/(Tmin+237.3));

es = (eTmax + eTmin)/2;

end
```

G.m

```
function G = G(Tmonthnext,Tmonthprevious)

G = 0.07*(Tmonthnext-Tmonthprevious);

end
```

gamma.m

```
function gamma = gamma(pressure,cp,lamda,epsilon)

gamma = (cp*pressure)/(epsilon*lamda);

end
```

gamma_c.m

```
function gamma_c = gamma_c(Latitude,Longitude,gamma_z,Java_with_axes)

x = Java_with_axes(end,2:end);
y = Java_with_axes(2:end,1)';

x_f = find(x>=Longitude-0.0041667 & x<=Longitude+0.0041667);
x_ff = round(mean(x_f));
y_f = find(y>=Latitude-0.0041667 & y<=Latitude+0.0041667);
y_ff = round(mean(y_f));

gamma_c = gamma_z(y_ff,x_ff);



end
```

P.m

```
function P = P(z)

P = 101.3*((293-0.0065*z)/293)^5.26;

end
```

Penman.m and Penman_New.m

```
function [ETo,alpha_f,beta_f] = Penman(DELTA,RN,SHF,ES,EA,GAMMA,T,u2)

cf = 0.408;   %Conversion factor to get from [MJ m-2 day-1] to [mm day-1].

ETo = (cf*DELTA*(RN-SHF) + GAMMA*900/(T+273)*u2*(ES-EA)) / ...

    (DELTA+GAMMA*(1+0.34*u2));

alpha_f = (cf*DELTA*(RN-SHF)) / (DELTA+GAMMA*(1+0.34*u2));

beta_f = (GAMMA*900/(T+273)*(ES-EA)) / (DELTA+GAMMA*(1+0.34*u2));



end
```

Penman_New.m

```
function [ETo,alpha_ac,beta_ac] = Penman_New(DELTA,RN,SHF,ES,EA,GAMMA,T,u2)

cf = 0.408;   %Conversion factor to get from [MJ m-2 day-1] to [mm day-1].

ETo = (cf*DELTA*(RN-SHF) + GAMMA*900/(T+273)*u2*(ES-EA)) / ...

    (DELTA+GAMMA*(1+0.34*u2));



alpha_ac = cf*(RN-SHF);
beta_ac  = 900/(T+273)*(ES-EA);

end
```

Rn.m

```
function [Rn,dr,phi,sdelta,omegas,Ra,N,Rs,Rso,Rns,Rnl] = ...
    Rn(eta,as,bs,n,J,Lat,sigma,TmaxK,TminK,EA,z,Gsc)

dr = 1 + 0.033*cos((2*pi)/365*J);

phi = pi/180*Lat;
sdelta = 0.4093*sin((2*pi*J/365)-1.39);

omegas = acos(-tan(phi)*tan(sdelta));

Ra = (24*(60))/pi*Gsc*dr*(omegas*sin(phi)*sin(sdelta) +
cos(phi)*cos(sdelta)*sin(omegas));

N = 24/pi*omegas;

Rs = (as + bs*n/N)*Ra;
Rso = (0.75 + 2e-5*z)*Ra;

Rns = (1 - eta)*Rs;
Rnl = sigma*((TmaxK^4+TminK^4)/2)*(0.34-0.14*sqrt(EA))*(1.35*Rs/Rso - 0.35);

Rn = Rns - Rnl;

end
```

Appendix III.b: Script files

Main_Interpolation_M1.m, Main_Interpolation_M2.m, Main_Interpolation_M3.m, Main_Interpolation_M4.m and Main_Interpolation_M5.m

When a part of marked code is preceded with (multiple times) “**[#]**”, where # is/are the number(s) at the end of the name(s) of the file(s), this means the code is only a part of that/those file(s). The code that is not a part of all files is marked grey. Unmarked code is used by all ‘Main_Interpolation_M#.m’-files.
This is done to reduce the size of this document significantly.

```
%First the workspace is cleaned up
clear all     %The variables are cleared.
close all     %The figures are closed.
clc           %The command window is cleared.
fclose('all');%Close all opened files.
format short  %The display format of the numbers is set to short.

%Here the month for which the output is wanted is set. When you set the
%month to 13, the average over the year is calculated.
Month = 1;

%The names of the stations are assigned here. These names should be the
%same as the names of the .TXT files with the data of the stations in it
%(for instance, the station 'Curug-Budiarto' has a .TXT file with its data
%in it named 'Curug-Budiarto.TXT'.
stations = {'Bandung','Bogor','Curug-Budiarto','Djember','Gunung Rosa',...
    'Jakarta','Karang Anjar','Kawah-Idjen','Lembang','Magelang','Pangerango',...

    'Pasuruan','Rarahan','Sawahan','Semarang','Surabaya','Rogodjampi',...
    'Tamansari','Tjipetir','Tosari','Cilacap','Yogyakarta','Serang','Tegal'};

%Here the user can assign which stations are left out. '[]' means no stations
%are left out. If you want to leave certain stations out, add their number
%between the brackets. For more than one station, separate the different
%numbers with a space. The number of the station is the column number of
%the station in the variable 'stations'.
leave_out = [];

%We can also choose which interpolation method should be used. There are
%four methods that can be used here:
%        - 'linear'    Triangle-based linear interpolation
%        - 'cubic'     Triangle-based cubic interpolation
%        - 'nearest'   Nearest neighbor interpolation
%        - 'v4'        MATLAB 4 griddata method
%
%It is recommended to use linear interpolation. The method can be set by
%changing the value for 'method' below:
method = 'linear';

%The size of one rectangle in the interpolation can be set. Changing the
%value for 'dx' below changes the size of one rectangle in the longitude
%direction. Changing the value for 'dy' changes the size of one rectangle
%in the latitude direction. The unit of dx and dy is decimal degrees.
dx = 1/60;
dy = 1/60;

%We run Altitude_matrix.m to load the matrix with the altitude data
%of Java.
run Altitude_matrix

%In the next for-loop, the numbers of the stations that are not left out
%are added to the variable 'loc'.
k = 1;
for n = 1:length(stations)
    tf = ismember(n, leave_out);
```

```
    if tf == 0
        loc(k) = n;
        k = k + 1;
    end
end

[1]%For the stations that are left out, the variables 'ETo_m', 'Latitude_c' and
%'Longitude_c' are assigned.
[2]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are assigned.
[3][4][5]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'gamma_m', delta_m', 'Latitude_c' and 'Longitude_c'
%are assigned.
for location = 1:length(stations)
        tf = ismember(location, leave_out);
        if tf == 1
            M = load([char(stations(location)) '.TXT']);
[1]         run RCE
[2]         run RCE
[3]         run RCE_New
[4]         run RCE_New
[5]         run RCE_New
            if Month == 13
                ETo_m(location) = mean(ETo);
[2][3][4][5]    u2_c(location) = mean(u2);
[2]             alpha_m(location) = mean(alpha_f);
[2]             beta_m(location) = mean(beta_f);
[3][4][5]       alpha_m(location) = mean(alpha_ac);
[3][4][5]       beta_m(location) = mean(beta_ac);
[3][4][5]       delta_m(location) = mean(delta_f);
[3][4][5]       gamma_m(location) = mean(gamma_f);
            else
                ETo_m(location) = ETo(Month);
[2][3][4][5]    u2_c(location) = 0.01157*M(Month+1,5);
[2]             alpha_m(location) = alpha_f(Month);
[2]             beta_m(location) = beta_f(Month);
[3][4][5]       alpha_m(location) = alpha_ac(Month);
[3][4][5]       beta_m(location) = beta_ac(Month);
[3][4][5]       delta_m(location) = delta_f(Month);
[3][4][5]       gamma_m(location) = gamma_f(Month);
            end
            Latitude_c(location) = Lat;
            Longitude_c(location) = Lon;
        end
end

[1]%For the stations that are left out, the variables 'ETo_m', 'Latitude_c' and
%'Longitude_c' are also assigned. Here also the variables 'Latitude_p',
%'Longitude_p' and 'ETo_p' are assigned.
[2]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are also assigned.
%Here also the variables 'Latitude_p', 'Longitude_p', 'ETo_p', 'alpha_p',
%'beta_p' and 'u2_p' are assigned.
[3][4][5]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are also assigned.
%Here also the variables 'Latitude_p', 'Longitude_p', 'ETo_p', 'alpha_p',
%'beta_p', 'gamma_p', 'delta_p' and 'u2_p' are assigned.
i = 1;
for location = 1:length(stations)
        tf = ismember(location, loc);
        if tf == 1
            M = load([char(stations(location)) '.TXT']);
[1]         run RCE
[2]         run RCE
[3]         run RCE_New
```

```
[4]             run RCE_New
[5]             run RCE_New
                Latitude_p(i) = Lat;
                Longitude_p(i) = Lon;
                Latitude_c(location) = Lat;
                Longitude_c(location) = Lon;
                if Month == 13
                    ETo_p(i) = mean(ETo);
[2][3][4][5]        u2_p(i) = mean(u2);
[2]                 alpha_p(i) = mean(alpha_f);
[2]                 beta_p(i) = mean(beta_f);
[3][4][5]           alpha_p(i) = mean(alpha_ac);
[3][4][5]           beta_p(i) = mean(beta_ac);
[3][4][5]           delta_p(i) = mean(delta_f);
[3][4][5]           gamma_p(i) = mean(gamma_f);

                    ETo_m(location) = mean(ETo);
[2][3][4][5]        u2_c(location) = mean(u2);
[2]                 alpha_m(location) = mean(alpha_f);
[2]                 beta_m(location) = mean(beta_f);
[3][4][5]           alpha_m(location) = mean(alpha_ac);
[3][4][5]           beta_m(location) = mean(beta_ac);
[3][4][5]           delta_m(location) = mean(delta_f);
[3][4][5]           gamma_m(location) = mean(gamma_f);
                else
                    ETo_p(i) = ETo(Month);
[2][3][4][5]        u2_p(i) = u2(Month);
[2]                 alpha_p(i) = alpha_f(Month);
[2]                 beta_p(i) = beta_f(Month);
[3][4][5]           alpha_p(i) = alpha_ac(Month);
[3][4][5]           beta_p(i) = beta_ac(Month);
[3][4][5]           delta_p(i) = delta_f(Month);
[3][4][5]           gamma_p(i) = gamma_f(Month);

                    ETo_m(location) = ETo(Month);
[2][3][4][5]        u2_c(location) = 0.01157*M(Month+1,5);
[2]                 alpha_m(location) = alpha_f(Month);
[2]                 beta_m(location) = beta_f(Month);
[3][4][5]           alpha_m(location) = alpha_ac(Month);
[3][4][5]           beta_m(location) = beta_ac(Month);
[3][4][5]           delta_m(location) = delta_f(Month);
[3][4][5]           gamma_m(location) = gamma_f(Month);
                end
                i = i + 1;
        end
end

scrsz = get(0,'ScreenSize'); %The screensize is used to make sure the figures are
shown in a nice way.

[1]%A figure is created with as name 'ETo'.
%The figure will fill your screen.
figure('Name','ETo','NumberTitle','off','Position',[7 38 (scrsz(3)-16) ...
    (scrsz(4)-115)])
[2]%The figures are created with as names 'ETo', 'alpha', 'beta' and 'u2'.
%Each of the figures will take 1/4 of your screen.
[3]%The figures are created with as names 'ETo', 'alpha_ac', 'beta_ac',
%'delta' and 'gamma'.
%Each of the last 4 figures will take 1/4 of your screen.
[4] [5]%Figures are created with as names 'ETo', 'alpha_ac', 'beta_ac' and
%'delta'.
%Each of the last 3 figures will take 1/4 of your screen.
[2][4][5]for n = 1:4
[3] for n = 1:5
```

```
[2]if n == 1
    Z = ETo_p;
    figure('Name','ETo','NumberTitle','off','Position',[7 123+(scrsz(4)- ...
        200)/2 (scrsz(3)-32)/2 (scrsz(4)-200)/2])
[3][4][5]if n == 1
    Z = ETo_p;
    figure('Name','ETo','NumberTitle','off','Position',[7 38 (scrsz(3)- ...
        16) (scrsz(4)-115)])
[2][3][4][5]elseif n == 2
    Z = alpha_p;
    figure('Name','alpha','NumberTitle','off','Position',[(scrsz(3)- ...
        32)/2+24 123+(scrsz(4)-200)/2 (scrsz(3)-32)/2 (scrsz(4)-200)/2])
[2][3][4][5]elseif n == 3
    Z = beta_p;
    figure('Name','beta','NumberTitle','off','Position',[(scrsz(3)-32)/2+ ...
        24 38 (scrsz(3)-32)/2 (scrsz(4)-200)/2])
[2]elseif n == 4
    Z = u2_p;
    figure('Name','u2','NumberTitle','off','Position',[7 38 (scrsz(3)- ...
        32)/2 (scrsz(4)-200)/2])
[3][4][5]elseif n == 4
    Z = delta_p;
    figure('Name','delta','NumberTitle','off','Position',[7 38 (scrsz(3)- ...
        32)/2 (scrsz(4)-200)/2])
[3]elseif n == 5
    Z = gamma_p;
    figure('Name','gamma','NumberTitle','off','Position',[7 123+(scrsz(4)- ...
        200)/2 (scrsz(3)-32)/2 (scrsz(4)-200)/2])
[2][3][4][5]end

[1]%In the figure the values the ETo of the stations in 'loc' are plotted. They
%are marked with a triangle.
[2]%In each of the figures the values of respectively the ETo, the alpha, the
%beta and the wind speed of the stations in 'loc' are plotted. They are
%marked with a triangle.
[3]%In each of the figures the values of respectively the ETo, alpha^, beta^,
%gamma and delta of the stations in 'loc' are plotted. They are marked with
%a triangle.
[4][5]%In each of the figures the values of respectively the ETo, alpha^, beta^,
%and delta of the stations in 'loc' are plotted. They are marked with
%a triangle.
[1]Z = ETo_p;
plot3(Longitude_p,Latitude_p,Z,'^')

%The position of the axes in the figure of the ETo is altered to make sure the
%elevation surface also fits in there.
[1]for n = 1
if n == 1
pos = get(gca,'Position');
newpos = pos+[0.08 0.46 -0.35*pos(3) -0.35*pos(4)];
set(gca,'Position',newpos)
end
[1]end

%Lines are plotted from the values marked with a triangle to a point with
%the same Longitude and Latitude but with Z = 0.
hold on
for k = 1:length(Latitude_p)
   x_line = [Longitude_p(k) Longitude_p(k)];
   y_line = [Latitude_p(k) Latitude_p(k)];
   z_line = [Z(k) 0];
   plot3(x_line,y_line,z_line,'-g.')
end
grid on
axis equal vis3d
```

```
%The ratio of the axes are adjusted to make the graphs look better.
[1]for n = 1
if n ~= 3
    set(gca,'DataAspectRatio',[1 1 2])
else
    set(gca,'DataAspectRatio',[1 1 0.5])
end
[1]end

%Assign coordinates boundaries:
x = West:dx:East;
y = South:dy:North;

%The surfaces with interpolated values are plotted.
[XI,YI] = meshgrid(x,y);
[1]ETo_interp = griddata(Longitude_p,Latitude_p,Z,XI,YI,method);
[2][3][4][5]ZI = griddata(Longitude_p,Latitude_p,Z,XI,YI,method);
[2][3][4][5]if n == 2
    alpha_c = ZI;
elseif n == 3

    beta_c = ZI;

[3][4][5]elseif n == 4

    delta_c = ZI;

[3]elseif n == 5

    gamma_c = ZI;

[2][3][4][5]end
surfc(XI,YI,ETo_interp,'EdgeColor','none')
colormap('Jet')
xlabel('Longitude [dec. degr.]')
ylabel('Latitude [dec. degr.]')

%The titles of the graphs are generated.
Monthname = {'January','February','March','April','May','June','July', ...
    'August','September','October','November','December'};
[1]zlabel('ETo [mm]')
if Month == 13;
    title('ETo averaged over the year')
else
    title(['ETo in ',char(Monthname(Month))])
[2][3][4][5]if n == 1
    zlabel('ETo [mm]')
    if Month == 13;
        title('ETo averaged over the year')
    else
        title(['ETo in ',char(Monthname(Month))])
    end
elseif n == 2
    zlabel('\alpha')
    if Month == 13;
        title('\alpha averaged over the year')
    else
        title(['\alpha in ',char(Monthname(Month))])
    end
elseif n == 3
    zlabel('\beta')
    if Month == 13;
        title('\beta averaged over the year')
    else
        title(['\beta in ',char(Monthname(Month))])
```

```
    end
[2]elseif n ==4
    zlabel('u2 [m/s]')
    if Month == 13;
        title('u2 averaged over the year')
    else
        title(['u2 in ',char(Monthname(Month))])
    end
 [3][4][5]elseif n == 4
    zlabel('\Delta')
    if Month == 13;
        title('\Delta averaged over the year')
    else
        title(['\Delta in ',char(Monthname(Month))])
    end
[3]elseif n == 5
    zlabel('\gamma')
    if Month == 13;
        title('\gamma averaged over the year')
    else
        title(['\gamma in ',char(Monthname(Month))])
    end
end

axis([West East  South  North]) %Sets the axis to show all of Java.
view([0,90])                    %Sets the view to a top-view.

[2][3][4][5]end

[4]%We make a matrix with the psychometric constant at each point of Java.
gamma_z = zeros(mm,nn);

for i = 1:mm
    for j = 1:nn
        if isnan(Java_land(i,j)) == 0
            gamma_z(i,j) = (1.013*10^-3)/(0.622*2.45)*101.3*((293-
0.0065*Java_land(i,j))/293)^5.26;
        else
            gamma_z(i,j) = (1.013*10^-3)/(0.622*2.45)*101.3*((293-
0.0065*0)/293)^5.26;
        end
    end
end

%A figure is made for the psychometric constant at each point of Java with as name
%'gamma'.
figure('Name','gamma','NumberTitle','off','Position',[7 123+(scrsz(4)-200)/2
(scrsz(3)-32)/2 (scrsz(4)-200)/2])

plot3(Longitude_p,Latitude_p,gamma_p,'^')

hold on
surf(x_deg,y_deg,gamma_z)

shading('interp')
xlabel('Longitude [dec. degr.]')
ylabel('Latitude [dec. degr.]')
grid on
axis vis3d
axis([West East  South  North])
view([0,90])
set(gca,'DataAspectRatio',[50 50 1])
zlabel('\gamma')
if Month == 13;
    title('\gamma averaged over the year')
else
    title(['\gamma in ',char(Monthname(Month))])
```

```
end

Z = gamma_p;
for k = 1:length(Latitude_p)
   x_line = [Longitude_p(k) Longitude_p(k)];
   y_line = [Latitude_p(k) Latitude_p(k)];
   z_line = [Z(k) 0];
   plot3(x_line,y_line,z_line,'-g.')
end

[1]%For each station in 'leave_out', the interpolated ETo will be determined.
%
%Also, the values of the measured ETo at the stations in 'leave_out' are
%added to the graph and are marked with an orange star.
%All the marked stations are also numbered in the graph, so the user can easily
%see which mark stands for which station.
[2]%For each station in 'leave_out', the ETo will be calculated using:
%   ETo = alpha + beta * u2.
%
%Also, the values of the measured ETo, alpha, beta and u2 at the stations
%in 'leave_out' are added to the graphs and are marked with an orange star.
%All the marked stations are also numbered in the graph, so you can easily
%see which mark stands for which station.
[3][4]%For each station in 'leave_out', the ETo will be calculated using:
% ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2).

%
%Also, the values of the measured ETo, alpha^, beta^, gamma and delta at
%the stations in 'leave_out' are added to the graphs and are marked with an
%orange star. All the marked stations are also numbered in the graph, so
%you can easily see which mark stands for which station.
[5]%For each station in 'leave_out', the ETo will be calculated using:
% ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2).

%
%Also, the values of the measured ETo, alpha^, beta^ and delta at the
%stations in 'leave_out' are added to the graphs and are marked with an
%orange star. All the marked stations are also numbered in the graph, so
%you can easily see which mark stands for which station.
for c = 1:length(leave_out)
    location = leave_out(c);
    y_c = find(y>=Latitude_c(location)-dy/2 & y<=Latitude_c(location)+dy/2);
    y_cc(c) = round(mean(y_c));
    x_c = find(x>=Longitude_c(location)-dx/2 & x<=Longitude_c(location)+dx/2);
    x_cc(c) = round(mean(x_c));

[1]     ETo_c(c) = ETo_interp(y_cc(c),x_cc(c));
[2]     ETo_c(c) = alpha_c(y_cc(c),x_cc(c))+beta_c(y_cc(c),x_cc(c))*u2_c(location);
[3][4][5]   D = delta_c(y_cc(c),x_cc(c));
[3]         g = gamma_c(y_cc(c),x_cc(c));

[4]         g = gamma_c(Latitude_c(location),Longitude_c(location),gamma_z, ...
                Java_with_axes);
                g_table(c) = g;
[5]         g = gamma_m(location);
                g_table(c) = g;
[3][4][5]   a = alpha_c(y_cc(c),x_cc(c));
            b = beta_c(y_cc(c),x_cc(c));

            u = u2_c(location);

        ETo_c(c) = ((D*a)+(g*b*u))/(D+g+(g*0.34*u));



   figure(1), plot3(Longitude_c(location),Latitude_c(location), ...
```

```
        ETo_m(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        ETo_m(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(1),text(Longitude_p(i),Latitude_p(i),ETo_m(loc(i))+0.25,num2str(loc(i)))
end

[2][3][4][5]for c = 1:length(leave_out)
    location = leave_out(c);
    figure(2), plot3(Longitude_c(location),Latitude_c(location), ...
        alpha_m(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        alpha_m(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(2),text(Longitude_p(i),Latitude_p(i), ...
        alpha_m(loc(i))+0.25,num2str(loc(i)))
end

[2][3][4][5]for c = 1:length(leave_out)
    location = leave_out(c);
    figure(3), plot3(Longitude_c(location),Latitude_c(location), ...
        beta_m(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        beta_m(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(3),text(Longitude_p(i),Latitude_p(i), ...
        beta_m(loc(i))+0.25,num2str(loc(i)))
end

[2]for c = 1:length(leave_out)
    location = leave_out(c);
    figure(4), plot3(Longitude_c(location),Latitude_c(location), ...
        u2_c(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        u2_c(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(4),text(Longitude_p(i),Latitude_p(i),u2_c(loc(i))+0.25,num2str(loc(i)))
end

[3][4][5]for c = 1:length(leave_out)
    location = leave_out(c);
    figure(4), plot3(Longitude_c(location),Latitude_c(location), ...
        delta_m(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        delta_m(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(4),text(Longitude_p(i),Latitude_p(i), ...
        delta_m(loc(i))+0.25,num2str(loc(i)))
end

[3][4]for c = 1:length(leave_out)
    location = leave_out(c);
    figure(5), plot3(Longitude_c(location),Latitude_c(location), ...
        gamma_m(location),'pk','MarkerFaceColor',[1 0.4 .2])
    text(Longitude_c(location),Latitude_c(location), ...
        gamma_m(location)+.25,num2str(location))
end
for i=1:length(loc)
    figure(5),text(Longitude_p(i),Latitude_p(i), ...
        gamma_m(loc(i))+0.25,num2str(loc(i)))
end

%Lines are plotted from the values marked with a star to a point with the
```

```
%same Longitude and Latitude but with Z = 0.
[2][4][5]for n = 1:4
[3]for n = 1:5
[2][3][4][5]figure(n)
for k = 1:length(leave_out)
    c = leave_out(k);
[1]   Z = ETo_m(c);
[2][3][4][5]if n == 1
        Z = ETo_m(c);
    elseif n == 2
        Z = alpha_m(c);
    elseif n == 3
        Z = beta_m(c);

[2]  elseif n == 4

        Z = u2_c(c);

[3][4][5]elseif n == 4

        Z = delta_m(c);

[3]  elseif n == 5

        Z = gamma_m(c);

[2][3][4][5]end
    x_line = [Longitude_c(c) Longitude_c(c)];
    y_line = [Latitude_c(c) Latitude_c(c)];
    z_line = [Z 0];
    plot3(x_line,y_line,z_line,'-r.')
end
[2][3][4][5]end

%A map representing the land of Java is added underneath the graph of ETo.
Java_border = zeros(mm,nn);
Java_border(1:end,1:end) = nan;

for i=1:mm
    for j=1:nn
        if isnan(Java_land(i,j))==0
            Java_border(i,j)=0;
        end
    end
end

x_deg = linspace(West,East,nn);
y_deg = linspace(South,North,mm);

figure(1)
surf(x_deg,y_deg,Java_border,'EdgeColor','none')

%The list of stations is added in the figure and stations in 'leave_out' are
%marked red.
[2][4][5]for n = 1:4
[3]for n = 1:5
[2][3][4][5]figure(n)
axes('units','centimeters','position',[0.5 1 2 2])
for i=1:length(stations)
    name = char(stations(i));
    if ismember(i, leave_out) == 1
        text(0,(length(stations)-1)*0.4-(i-1)*0.4,[num2str(i),':  ', ...
            name],'Color','r')
    else
        text(0,(length(stations)-1)*0.4-(i-1)*0.4,[num2str(i),':  ', name])
    end
```

```
end
set(gca,'xlim',[0 2],'ylim',[0 2],'visible','off')
view(2)
[2][3][4][5]end

%A graph with the altitude of Java is added in another axes in the figure
%'ETo'.
[2][3][4][5]figure(1)
axes('position',newpos+[0 -0.33 0 0])
surf(x_deg,y_deg,Java_land)
shading('interp')
xlabel('Longitude [dec. degr.]')
ylabel('Latitude [dec. degr.]')
axis([West East  South  North])
view([0,90])
set(gca,'DataAspectRatio',[1 1 5000])

[1]%A table is generated for comparing the ETo as calculated from measurements
%with the values calculated from interpolation.
[2]%A table is generated for comparing ETo, alpha and beta calculated from
%measurements with the values calculated from taking the interpolated
%alpha, interpolated beta and measured wind speed and applying the
%equation (ETo = alpha + beta * u2).
[3]%A table is generated for comparing ETo, alpha^, beta^, gamma and delta
%calculated from measurements with the values calculated from taking the
%interpolated alpha^, interpolated beta^, interpolated gamma, interpolated
%delta and measured wind speed and applying the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))

[4]%A table is generated for comparing ETo, alpha^, beta^, gamma and delta
%calculated from measurements with the values calculated from taking the
%interpolated alpha^, interpolated beta^, gamma calculated from the
%altitude matrix, interpolated delta and measured wind speed and applying
%the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))
[5]%A table is generated for comparing ETo, alpha^, beta^ and delta calculated
%from measurements with the values calculated from taking the interpolated
%alpha^, interpolated beta^, gamma calculated with the given altitude,
%interpolated delta and measured wind speed and applying the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))

[1]table_ETo_c=zeros(length(leave_out),3);
[2]table_ETo_c=zeros(length(leave_out),8);
[3][4][5]table_ETo_c=zeros(length(leave_out),12);
for i=1:length(leave_out)
    table_ETo_c(i,1)=leave_out(i);
[1]  table_ETo_c(i,2)=ETo_c(i);
    table_ETo_c(i,3)=ETo_m(leave_out(i));
[2][3][4][5]table_ETo_c(i,2)=alpha_c(y_cc(i),x_cc(i));
    table_ETo_c(i,3)=alpha_m(leave_out(i));
    table_ETo_c(i,4)=beta_c(y_cc(i),x_cc(i));
    table_ETo_c(i,5)=beta_m(leave_out(i));
[2]  table_ETo_c(i,6)=u2_c(leave_out(i));
    table_ETo_c(i,7)=ETo_c(i);
    table_ETo_c(i,8)=ETo_m(leave_out(i));
[3][4][5]table_ETo_c(i,6)=delta_c(y_cc(i),x_cc(i));
    table_ETo_c(i,7)=delta_m(leave_out(i));
[3]  table_ETo_c(i,8)=gamma_c(y_cc(i),x_cc(i));
[4][5] table_ETo_c(i,8)=g_table(i);
[3][4][5]table_ETo_c(i,9)=gamma_m(leave_out(i));
    table_ETo_c(i,10)=u2_c(leave_out(i));
    table_ETo_c(i,11)=ETo_c(i);
    table_ETo_c(i,12)=ETo_m(leave_out(i));
end

%This table is saved in a file called 'table.txt' and is also shown in the
```

```
%command window and in the figure 'ETo'.
n1 = size(table_ETo_c,1);
n2 = size(table_ETo_c,2);

fid = fopen('table.txt','w');

[1]thead ='Location  Name                  ETo(IP)   ETo(CfM)';
[2]thead ='Location  Name                  alpha(IP) alpha(CfM)beta(IP)  beta(CfM)
u2(M)     ETo(CfI)  ETo(CfM)';
[3][4][5]thead ='Nr. Name              alpha-I  alpha-CM beta-I    beta-CM  Delta-I
Delta-CM gamma-I  gamma-CM u2-M     ETo-CI   ETo-CM';
fprintf(fid,'%s\n',thead);
[1]fprintf(fid,'%s\n','----------------------------------------------');
[2]fprintf(fid,'%s\n','------------------------------------------------------------------
--------------------------------------');
[3][4][5]fprintf(fid,'%s\n','-------------------------------------------------------
---------------------------------------------------------------');

for i1=1:n1
  i3    = leave_out(i1);
  cc    = stations{i3};
  zstat = '               ';
  zstat(1:length(cc))=cc;
  zline = [num2str(table_ETo_c(i1,1),'%02i') '        ' zstat '   '];
  for i2=2:n2
    zline = [zline '    ' num2str(table_ETo_c(i1,i2),'%5.5f')];
  end
  fprintf(fid,'%s\n',zline);
end

fprintf(fid,'\n');
[1][2]fprintf(fid,'%s\n','IP  = interpolated');
[2]fprintf(fid,'%s\n','M   = measured');
[2]fprintf(fid,'%s\n','CfI = calculated from interpolation');
[1][2]fprintf(fid,'%s\n','CfM = calculated from measurements');
[3][4][5]fprintf(fid,'%s\n','-I  = interpolated');
fprintf(fid,'%s\n','-M  = measured');
fprintf(fid,'%s\n','-CI = calculated from interpolation');
fprintf(fid,'%s\n','-CM = calculated from measurements');

fclose(fid);

iend=0;
count=0;
fid = fopen('table.txt');

figure(1), axes('units','centimeters','position',[7 1 2 2]), ...
    set(gca,'xlim',[0 2],'ylim',[0 2],'visible','off'),view(2)
while iend==0
    count=count+1;
    t = fgets(fid);
    text(0,(6+length(leave_out)-1)*0.5-(count-1)*0.5,t,'FontName','Courier New')
    if count ~= length(leave_out)+2
    t = t(1:(length(t)-1));
    end
    disp(t)
    iend=feof(fid);
end
```

RCE.m and RCE_New.m

When a part of marked code is preceded with “**[Old]**”, this means the code is only a part of ‘RCE.m’. When a part of marked code is preceded with “**[New]**”, this means the code is only a part of ‘RCE_New.m’. The code that is only a part of either one of the files is marked grey. Unmarked code is a part of both ‘RCE.m’ and ‘RCE_New.m’.

This is done to reduce the size of this document significantly.

```
%#Options#
%It is advised to keep both 'show_table' and 'show_plot' set to 0 when
%running 'Main_Interpolation_M#.m'. When the values are set to one, then a lot
%of tables and figures will be shown when running 'Main_Interpolation_M#.m'.
%This also counts when running 'Results_M#.m'.
show_table = 0;   %When this value is set to one, a table will be shown in
                  %the command window with monthly values of ETo, alpha and
                  %beta.
                  %Any other value will make sure the table won't be shown.
show_plot  = 0;   %When this value is set to one, a plot will be shown in a
                  %new figure with monthly values of ETo, alpha and beta.
                  %Any other value will make sure the plot won't be shown.

%Variables:

%Making empty matrices for certain variables
n = zeros(1,12);
Tmax = zeros(1,12);
Tmin = zeros(1,12);
RH = zeros(1,12);
u2 = zeros(1,12);

%Assigning input values from the matrix 'M' to the individual variable
%names. The matrix 'M' can either be defined manually or it is loaded in
%'Main_Interpolation.m'.
for k = 1:12
    n(k) = M(k+1,6);             %actual duration of sunshine [hours]
    Tmax(k) = M(k+1,2);          %mean of the daily maximum temperatures in degrees
                                 %Celsius [°C]
    Tmin(k) = M(k+1,3);          %mean of the daily minimum temperatures in degrees
                                 %Celsius [°C]
    u2(k) = 0.01157*M(k+1,5);    %wind speed measured at 2m height [m s-1]
    RH(k) = M(k+1,4);            %the relative humidity [%]
end
str_Lat = cur2frac(M(1,1), 100);
dec_Lat = frac2cur(str_Lat, 60);
str_Lon = cur2frac(M(1,2), 100);
dec_Lon = frac2cur(str_Lon, 60);

Lat = dec_Lat;                   %latitude of the position [dec. deg.]
Lon = dec_Lon;                   %longitude of the position [dec. deg.]
z = M(1,3);                      %elevation above sea level [m]

q=1:12;
J(q) = round(30.4*q-15);         %number of the day in the year

T = (Tmax+Tmin)/2;               %mean daily temperature in degrees Celsius [°C]
                                 %measured at 2m height
TmaxK = Tmax + 273;              %maximum absolute temperature during the 24-hour
                                 %period [K]
TminK = Tmin + 273;              %minimum absolute temperature during the 24-hour
                                 %period [K]

for k=1:12
    if k==12
        Tmonthnext(k) = T(1);          %mean daily temperature in degrees Celsius
                                       %[°C] from the next month
        Tmonthprevious(k) = T(k-1);    %mean daily temperature in degrees Celsius
                                       %[°C] from the previous month
```

```
    elseif k==1
        Tmonthnext(k) = T(k+1);
        Tmonthprevious(k) = T(12);
    else
        Tmonthnext(k) = T(k+1);
        Tmonthprevious(k) = T(k-1);
    end
end

%Parametres:
eta = 0.23;             %albedo or canopy reflection coefficient [-]
as = 0.25;              %regression constant, expressing the fraction of
                        %extraterrestrial radiation reaching the earth on overcast
                        %days (n = 0) [-]
bs = 0.50;              %additional regression constant, expressing the extra
                        %fraction of extraterrestrial radiation reaching the earth
                        %during sunshine hours [-]
sigma = 4.903e-9;       %Stefan-Boltzmann constant [MJ K-4 m-2 day-1]
Gsc = 0.0820;           %Solar constant [MJ m-2 min-1]
h = 0.12;               %crop height [m]
rl = 100;               %bulk stomatal resistance of the well-illuminated leaf
                        %[s m-1]
cp = 1.013e-3;          %specific heat at constant pressure [MJ kg-1 °C-1]
lamda = 2.45;           %latent heat of vaporization [MJ kg-1]
epsilon = 0.622;        %ratio molecular weight of water vapour/dry air [-]

%Calculations for every month
for m=1:12              %A for-loop is used to calculate the ETo, alpha and beta
                        %for every month from 1 (=January) to 12 (=December).

%First the input for the FAO 56 Penman-Monteith equation is calculated,
%which will then be used in Penman.m. The variables that are used as input
%for the Penman-Monteith equation have names in only capital letters.

%The function file delta.m is used to calculate DELTA
DELTA = delta(T(m));   %slope of the saturation vapour pressure temperature
                       %relationship [kPa °C-1]

%The function file ea.m is used to calculate EA
EA = ea(Tmin(m),Tmax(m),RH(m));    %actual vapour pressure [kPa]

%The function file Rn.m is used to calculate RN, dr, phi, sdelta, omegas,
%Ra, N, Rs, Rso, Rns and Rnl
[RN,dr,phi,sdelta,omegas,Ra,N,Rs,Rso,Rns,Rnl] = ...
    Rn(eta,as,bs,n(m),J(m),Lat,sigma,TmaxK(m),TminK(m),EA,z,Gsc);
    % RN:        net radiation at the crop surface [MJ m-2 day-1]
    % dr:        inverse relative distance Earth-Sun
    % phi:       latitude [rad]
    % sdelta:    solar declination [rad]
    % omegas:    sunset hour angle [rad]
    % Ra:        extraterrestrial radiation [MJ m-2 day-1]
    % N:         daylight hours [hour]
    % Rs:        incoming solar or shortwave radiation [MJ m-2 day-1]
    % Rso:       clear-sky radiation [MJ m-2 day-1]
    % Rns:       net solar or shortwave radiation [MJ m-2 day-1]
    % Rnl:       net outgoing longwave radiation [MJ m-2 day-1]
%
%note: from the output of the function Rn.m only RN is used in Penman.m,
%the rest of the output is given so it can be checked.

%The function file G.m is used to calculate SHF
SHF = G(Tmonthnext(m),Tmonthprevious(m));   %soil heat flux density [MJ m-2 day-1]

%The function file es.m is used to calculate ES
ES = es(Tmax(m),Tmin(m));    %saturation vapour pressure [kPa]

    %The function file P.m is used to calculate pressure
    pressure = P(z);   %atmospheric pressure [kPa]
```

```
%The function file gamma.m is used to calculate GAMMA
GAMMA = gamma(pressure,cp,lamda,epsilon);    %psychrometric constant [kPa °C-1]

[Old]%The function file Penman.m is used to calculate ETo(m), alpha_f(m) and
%beta_f(m).
[ETo(m),alpha_f(m),beta_f(m)] = Penman(DELTA,RN,SHF,ES,EA,GAMMA,T(m),u2(m));
    %ETo(m):      The calculated values for the reference crop
    %             evapotranspiration of every month m at a specific
    %             measurement station.
    %alpha_f(m):  The calculated values for alpha of every month m at a
    %             specific measurement station.
    %beta_f(m):   The calculated values for beta of every month m at a
    %             specific measurement station.

[New]%The function file Penman.m is used to calculate ETo(m), alpha_ac(m) and
%beta_ac(m).
[ETo(m),alpha_ac(m),beta_ac(m)] = Penman_New(DELTA,RN,SHF,ES,EA,GAMMA,T(m),u2(m));
    %ETo(m):      The calculated values for the reference crop
    %             evapotranspiration of every month m at a specific
    %             measurement station.
    %alpha_ac(m): The calculated values for alpha^ of every month m at a
    %              specific measurement station.
    %beta_ac(m):  The calculated values for beta^ of every month m at a
    %              specific measurement station.

[New]gamma_f(m) = GAMMA;
delta_f(m) = DELTA;

end

[Old]%Show a table with montly variations in ETo, u2, alpha and beta
%This table is only shown if show_table is set to 1 at line 52 of this
%script file.
[New]%Show a table with montly variations in ETo, u2, alpha^, beta^, gamma
%and delta.
%This table is only shown if show_table is set to 1 at line 58 of this
%script file.
if show_table == 1
    disp(' ')
[Old] disp('Montly variations in ETo, alpha and beta:')
    disp('    Month     ETo        u2         alpha      beta')
    table=zeros(12,5);
[New]disp('Montly variations in ETo, u2, alpha_ac, beta_ac, gamma and delta:')
    disp('    Month     ETo        u2         alpha_ac  beta_ac   gamma     delta')
    table=zeros(12,7);
    for i=1:12
        table(i,1)=i;
        table(i,2)=ETo(i);
        table(i,3)=u2(i);
[Old]    table(i,4)=alpha_f(i);
        table(i,5)=beta_f(i);
[New]    table(i,4)=alpha_ac(i);
        table(i,5)=beta_ac(i);
        table(i,6)=gamma_f(i);
        table(i,7)=delta_f(i);
    end
    disp(table)
    disp('Average')
[Old] avg_2=[0 mean(table(:,2)) mean(table(:,3)) mean(table(:,4)) mean(table(:,5))];
[New]avg_2=[0 mean(table(:,2)) mean(table(:,3)) mean(table(:,4))...
        mean(table(:,5)) mean(table(:,6)) mean(table(:,7))];
    disp(avg_2)
end

[Old]%Plot monthly variations in ETo, u2, alpha and beta.
%This plot is only shown if show_plot is set to 1 at line 56 of this script
```

```
%file.
[New]%Plot monthly variations in ETo, u2, alpha^, beta^, gamma and delta.
%This plot is only shown if show_plot is set to 1 at line 62 of this script
%file.
month=1:12;
if show_plot == 1
[Old] figure(1),plot(month,alpha_f,'b.-')
[New]figure(1),plot(month,alpha_ac,'b.-')
    hold on
[Old] plot(month,beta_f,'g.-')
[New]plot(month,beta_ac,'g.-')
[New]plot(month,gamma_f,'c.-')
[New]plot(month,delta_f,'m.-')
    plot(month,ETo,'r.-')
    plot(month,u2,'y.-')
[Old] legend1 = legend('alpha','beta','ETo','u2','Location','Best');
[New]legend1 = legend('alpha','beta','u2','ETo','gamma','delta','Location','Best');
    xlabel('month in the year')
    ylabel('values')
    xlim([1 12]);
end
```

Results_M1.m, Results_M2.m, Results_M3.m, Results_M4.m and Results_M5.m

When a part of marked code is preceded with (multiple times) “**[#]**”, where # is/are the number(s) at the end of the name(s) of the file(s), this means the code is only a part of that/those file(s). The code that is not a part of all files is marked grey. Unmarked code is used by all ‘Main_Interpolation_M#.m’-files.

This is done to reduce the size of this document significantly.

```
%First the workspace is cleaned up
clear all     %The variables are cleared.
close all     %The figures are closed.
clc           %The command window is cleared.
fclose('all');%Close all opened files.

format short  %The display format of the numbers is set to short.

%The size of one rectangle in the interpolation can be set. Changing the
%value for 'dx' below changes the size of one rectangle in the longitude
%direction. Changing the value for 'dy' changes the size of one rectangle
%in the latitude direction. The unit of dx and dy is decimal degrees.
dx = 1/60;
dy = 1/60;

%We can also choose which interpolation method should be used. There are
%four methods that can be used here:
%        - 'linear'    Triangle-based linear interpolation
%        - 'cubic'     Triangle-based cubic interpolation
%        - 'nearest'   Nearest neighbor interpolation
%        - 'v4'        MATLAB 4 griddata method
%
%It is recommended to use linear interpolation. The method can be set by
%changing the value for 'method' below:
method = 'linear';

for s = [1 2 3 4 5 7 9 10 11 12 13 14 15 20 22 24] %for all stations
for Month = 1:13                                   %for all months and the average over the year

close all

%The names of the stations are assigned here. These names should be the
%same as the names of the .TXT files with the data of the stations in it
%(for instance, the station 'Curug-Budiarto' has a .TXT file with its data
%in it named 'Curug-Budiarto.TXT'.
```

```
stations = {'Bandung','Bogor','Curug-Budiarto','Djember','Gunung Rosa',...
'Jakarta','Karang Anjar','Kawah-Idjen','Lembang','Magelang','Pangerango',...
'Pasuruan','Rarahan','Sawahan','Semarang','Surabaya','Rogodjampi',...
'Tamansari','Tjipetir','Tosari','Cilacap','Yogyakarta','Serang','Tegal'};



%Here the station 's' is assigned to be left out in the interpolation
%process.
leave_out = [s];

%In the next for-loop, the numbers of the stations that are not left out
%are added to the variable 'loc'.
k = 1;
for n = 1:length(stations)
    tf = ismember(n, leave_out);
    if tf == 0
        loc(k) = n;
        k = k + 1;
    end
end

[1]%For the stations that are left out, the variables 'ETo_m', 'Latitude_c' and
%'Longitude_c' are assigned.
[2]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are assigned.
[3][4][5]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'gamma_m', delta_m', 'Latitude_c' and 'Longitude_c'
%are assigned.
for location = 1:length(stations)
        tf = ismember(location, leave_out);
        if tf == 1
            M = load([char(stations(location)) '.TXT']);

[1]         run RCE
[2]         run RCE
[3]         run RCE_New
[4]         run RCE_New
[5]         run RCE_New

            if Month == 13
                ETo_m(location) = mean(ETo);
[2][3][4][5]    u2_c(location) = mean(u2);
[2]             alpha_m(location) = mean(alpha_f);
[2]             beta_m(location) = mean(beta_f);
[3][4][5]       alpha_m(location) = mean(alpha_ac);
[3][4][5]       beta_m(location) = mean(beta_ac);
[3][4][5]       delta_m(location) = mean(delta_f);
[3][4][5]       gamma_m(location) = mean(gamma_f);
            else
                ETo_m(location) = ETo(Month);
[2][3][4][5]    u2_c(location) = 0.01157*M(Month+1,5);
[2]             alpha_m(location) = alpha_f(Month);
[2]             beta_m(location) = beta_f(Month);
[3][4][5]       alpha_m(location) = alpha_ac(Month);
[3][4][5]       beta_m(location) = beta_ac(Month);
[3][4][5]       delta_m(location) = delta_f(Month);
[3][4][5]       gamma_m(location) = gamma_f(Month);
            end

            Latitude_c(location) = Lat;
            Longitude_c(location) = Lon;
        end
end
```

```
[1]%For the stations that are left out, the variables 'ETo_m', 'Latitude_c' and
%'Longitude_c' are also assigned. Here also the variables 'Latitude_p',
%'Longitude_p' and 'ETo_p' are assigned.
[2]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are also assigned.
%Here also the variables 'Latitude_p', 'Longitude_p', 'ETo_p', 'alpha_p',
%'beta_p' and 'u2_p' are assigned.
[3][4][5]%For the stations that are left out, the variables 'u2_c','ETo_m',
%'alpha_m', 'beta_m', 'Latitude_c' and 'Longitude_c' are also assigned.
%Here also the variables 'Latitude_p', 'Longitude_p', 'ETo_p', 'alpha_p',
%'beta_p', 'gamma_p', 'delta_p' and 'u2_p' are assigned.
i = 1;
for location = 1:length(stations)
        tf = ismember(location, loc);
        if tf == 1
            M = load([char(stations(location)) '.TXT']);

[1]         run RCE
[2]         run RCE
[3]         run RCE_New
[4]         run RCE_New
[5]         run RCE_New

            Latitude_p(i) = Lat;
            Longitude_p(i) = Lon;

            Latitude_c(location) = Lat;
            Longitude_c(location) = Lon;

            if Month == 13
                ETo_p(i) = mean(ETo);
[2][3][4][5]    u2_p(i) = mean(u2);
[2]             alpha_p(i) = mean(alpha_f);
[2]             beta_p(i) = mean(beta_f);
[3][4][5]       alpha_p(i) = mean(alpha_ac);
[3][4][5]       beta_p(i) = mean(beta_ac);
[3][4][5]       delta_p(i) = mean(delta_f);
[3][4][5]       gamma_p(i) = mean(gamma_f);

                ETo_m(location) = mean(ETo);
[2][3][4][5]    u2_c(location) = mean(u2);
[2]             alpha_m(location) = mean(alpha_f);
[2]             beta_m(location) = mean(beta_f);
[3][4][5]       alpha_m(location) = mean(alpha_ac);
[3][4][5]       beta_m(location) = mean(beta_ac);
[3][4][5]       delta_m(location) = mean(delta_f);
[3][4][5]       gamma_m(location) = mean(gamma_f);
            else
                ETo_p(i) = ETo(Month);
[2][3][4][5]    u2_p(i) = u2(Month);
[2]             alpha_p(i) = alpha_f(Month);
[2]             beta_p(i) = beta_f(Month);
[3][4][5]       alpha_p(i) = alpha_ac(Month);
[3][4][5]       beta_p(i) = beta_ac(Month);
[3][4][5]       delta_p(i) = delta_f(Month);
[3][4][5]       gamma_p(i) = gamma_f(Month);

                ETo_m(location) = ETo(Month);
[2][3][4][5]    u2_c(location) = 0.01157*M(Month+1,5);
[2]             alpha_m(location) = alpha_f(Month);
[2]             beta_m(location) = beta_f(Month);
[3][4][5]       alpha_m(location) = alpha_ac(Month);
[3][4][5]       beta_m(location) = beta_ac(Month);
[3][4][5]       delta_m(location) = delta_f(Month);
```

```
[3][4][5]           gamma_m(location) = gamma_f(Month);
            end

            i = i + 1;
        end
end

[2][3][4][5]%The values of the appropriate matrix are set to be the values on the Z
%axis of the surface.
[2]if n == 1
    Z = ETo_p;
[3][4][5]if n == 1
    Z = ETo_p;
[2][3][4][5]elseif n == 2
    Z = alpha_p;
[2][3][4][5]elseif n == 3

    Z = beta_p;

[2]elseif n == 4

    Z = u2_p;

[3][4][5]elseif n == 4
    Z = delta_p;
[3]elseif n == 5
    Z = gamma_p;
[2][3][4][5]end

%Assign coordinates boundaries:
x = West:dx:East;
y = South:dy:North;

%The surface with interpolated values of ETo is made.
[XI,YI] = meshgrid(x,y);
[1]ETo_interp = griddata(Longitude_p,Latitude_p,ETo_p,XI,YI,method);
[2][3][4][5]ZI = griddata(Longitude_p,Latitude_p,Z,XI,YI,method);
[2][3][4][5]if n == 2
    alpha_c = ZI;
elseif n == 3

    beta_c = ZI;

[3][4][5]elseif n == 4

    delta_c = ZI;

[3]elseif n == 5

    gamma_c = ZI;

[2][3][4][5]end

[1]%For each station in 'leave_out', the interpolated ETo will be determined.
[2]%For each station in 'leave_out', the ETo will be calculated using:
%   ETo = alpha + beta * u2.
[3][4][5]%For each station in 'leave_out', the ETo will be calculated using:
% ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2).

for c = 1:length(leave_out)
    location = leave_out(c);
    y_c = find(y>=Latitude_c(location)-dy/2 & y<=Latitude_c(location)+dy/2);
    y_cc(c) = round(mean(y_c));
    x_c = find(x>=Longitude_c(location)-dx/2 & x<=Longitude_c(location)+dx/2);
    x_cc(c) = round(mean(x_c));
```

```
[1]   ETo_c(c) = ETo_interp(y_cc(c),x_cc(c));
[2]   ETo_c(c) = alpha_c(y_cc(c),x_cc(c))+beta_c(y_cc(c),x_cc(c))*u2_c(location);
[3][4][5]   D = delta_c(y_cc(c),x_cc(c));
[3]         g = gamma_c(y_cc(c),x_cc(c));

[4]         g = gamma_c(Latitude_c(location),Longitude_c(location),gamma_z, ...
                Java_with_axes);
                g_table(c) = g;
[5]         g = gamma_m(location);
                g_table(c) = g;
[3][4][5]   a = alpha_c(y_cc(c),x_cc(c));
            b = beta_c(y_cc(c),x_cc(c));

            u = u2_c(location);

    ETo_c(c) = ((D*a)+(g*b*u))/(D+g+(g*0.34*u));

end

[1]%A table is generated for comparing the ETo as calculated from measurements
%with the values calculated from interpolation.
[2]%A table is generated for comparing ETo, alpha and beta calculated from
%measurements with the values calculated from taking the interpolated
%alpha, interpolated beta and measured wind speed and applying the
%equation (ETo = alpha + beta * u2).
[3]%A table is generated for comparing ETo, alpha^, beta^, gamma and delta
%calculated from measurements with the values calculated from taking the
%interpolated alpha^, interpolated beta^, interpolated gamma, interpolated
%delta and measured wind speed and applying the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))

[4]%A table is generated for comparing ETo, alpha^, beta^, gamma and delta
%calculated from measurements with the values calculated from taking the
%interpolated alpha^, interpolated beta^, gamma calculated from the
%altitude matrix, interpolated delta and measured wind speed and applying
%the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))
[5]%A table is generated for comparing ETo, alpha^, beta^ and delta calculated
%from measurements with the values calculated from taking the interpolated
%alpha^, interpolated beta^, gamma calculated with the given altitude,
%interpolated delta and measured wind speed and applying the equation.
%(ETo = (delta * alpha^ + gamma * beta^ * u2)/(delta + gamma + gamma * 0.34 * u2))

[1]table_ETo_c=zeros(length(leave_out),3);
[2]table_ETo_c=zeros(length(leave_out),8);
[3][4][5]table_ETo_c=zeros(length(leave_out),12);
for i=1:length(leave_out)
    table_ETo_c(i,1)=leave_out(i);
[1]  table_ETo_c(i,2)=ETo_c(i);
    table_ETo_c(i,3)=ETo_m(leave_out(i));
[2][3][4][5]table_ETo_c(i,2)=alpha_c(y_cc(i),x_cc(i));
    table_ETo_c(i,3)=alpha_m(leave_out(i));
    table_ETo_c(i,4)=beta_c(y_cc(i),x_cc(i));
    table_ETo_c(i,5)=beta_m(leave_out(i));
[2]  table_ETo_c(i,6)=u2_c(leave_out(i));
    table_ETo_c(i,7)=ETo_c(i);
    table_ETo_c(i,8)=ETo_m(leave_out(i));
[3][4][5]table_ETo_c(i,6)=delta_c(y_cc(i),x_cc(i));
    table_ETo_c(i,7)=delta_m(leave_out(i));
[3]  table_ETo_c(i,8)=gamma_c(y_cc(i),x_cc(i));
[4][5] table_ETo_c(i,8)=g_table(i);
[3][4][5]table_ETo_c(i,9)=gamma_m(leave_out(i));
    table_ETo_c(i,10)=u2_c(leave_out(i));
    table_ETo_c(i,11)=ETo_c(i);
```

```
    table_ETo_c(i,12)=ETo_m(leave_out(i));
end

%This table is saved in a file called 'table.txt' and is also shown in the
%command window.
n1 = size(table_ETo_c,1);
n2 = size(table_ETo_c,2);

fid = fopen('table.txt','w');

[1]thead ='Location  Name                   ETo(IP)    ETo(CfM)';
[2]thead ='Location  Name                   alpha(IP) alpha(CfM)beta(IP)   beta(CfM)
u2(M)      ETo(CfI)   ETo(CfM)';
[3][4][5]thead ='Nr. Name                alpha-I  alpha-CM beta-I    beta-CM  Delta-I
Delta-CM gamma-I  gamma-CM u2-M      ETo-CI    ETo-CM';
fprintf(fid,'%s\n',thead);
[1]fprintf(fid,'%s\n','----------------------------------------------');
[2]fprintf(fid,'%s\n','--------------------------------------------------------------------
-------------------------------------');
[3][4][5]fprintf(fid,'%s\n','----------------------------------------------------------------
-----------------------------------------------------------------');

for i1=1:n1
  i3     = leave_out(i1);
  cc     = stations{i3};
  zstat = '               ';
  zstat(1:length(cc))=cc;
  zline = [num2str(table_ETo_c(i1,1),'%02i') '         ' zstat '   '];
  for i2=2:n2
    zline = [zline '    '  num2str(table_ETo_c(i1,i2),'%5.5f')];
  end
  fprintf(fid,'%s\n',zline);
end

if Month == 13
fprintf(fid,'\n');
[1][2]fprintf(fid,'%s\n','IP  = interpolated');
[2]fprintf(fid,'%s\n','M   = measured');
[2]fprintf(fid,'%s\n','CfI = calculated from interpolation');
[1][2]fprintf(fid,'%s\n','CfM = calculated from measurements');
[3][4][5]fprintf(fid,'%s\n','-I  = interpolated');
fprintf(fid,'%s\n','-M  = measured');
fprintf(fid,'%s\n','-CI = calculated from interpolation');
fprintf(fid,'%s\n','-CM = calculated from measurements');
end

fclose(fid);

iend=0;
count=0;
fid = fopen('table.txt');

while iend==0
    count=count+1;
    t = fgets(fid);
    t = t(1:(length(t)-1));
    disp(t)
    iend=feof(fid);
end

end

end
```

Appendix IV: Results for each station and each month

The following abbreviations are used in the top of the tables: CfM = Calculated from Measurements, CfI = Calculated from Interpolation, M = Measured, IP = Interpolated.

Appendix IV.a: Method 1 with linear interpolation

Station 1: Bandung			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.42974	3.89849	-12.02%
2	3.44448	3.97067	-13.25%
3	3.39780	3.93573	-13.67%
4	3.19522	3.66145	-12.73%
5	2.93363	3.38944	-13.45%
6	2.83491	3.20428	-11.53%
7	2.91714	3.41575	-14.60%
8	3.39129	3.85352	-12.00%
9	3.67386	4.23098	-13.17%
10	3.72254	4.14705	-10.24%
11	3.59200	3.91990	-8.37%
12	3.32858	3.94828	-15.70%
Average	3.32177	3.79796	-12.56%

Station 2: Bogor			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.60817	3.63145	-0.64%
2	3.69746	3.76544	-1.81%
3	3.81717	3.99283	-4.40%
4	3.75409	4.01561	-6.51%
5	3.53497	3.68994	-4.20%
6	3.41200	3.59839	-5.18%
7	3.69630	3.82450	-3.35%
8	4.07832	4.28039	-4.72%
9	4.40873	4.81245	-8.39%
10	4.25449	4.73173	-10.09%
11	4.01836	4.32243	-7.03%
12	3.65059	3.88899	-6.13%
Average	3.82755	4.04618	-5.20%

Station 3: Curug-Budiarto			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.94950	4.52963	-12.81%
2	4.04192	4.65777	-13.22%
3	4.37292	4.76328	-8.20%
4	4.28746	4.68849	-8.55%
5	3.96752	4.21887	-5.96%
6	3.80476	4.02395	-5.45%
7	4.01223	4.27544	-6.16%
8	4.48557	4.84760	-7.47%
9	4.94121	5.36224	-7.85%
10	4.93513	5.26973	-6.35%
11	4.58762	5.05208	-9.19%
12	4.17119	4.56378	-8.60%
Average	4.29642	4.68774	-8.32%

Station 4: Djember			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.57682	4.23659	-15.57%
2	3.74862	4.35606	-13.94%
3	3.69194	4.36241	-15.37%
4	3.56919	4.10308	-13.01%
5	3.08099	3.59263	-14.24%
6	2.92419	3.28643	-11.02%
7	2.94923	3.29496	-10.49%
8	3.22267	3.80521	-15.31%
9	3.76691	4.50034	-16.30%
10	4.08413	4.81514	-15.18%
11	3.86038	4.69302	-17.74%
12	3.76678	4.32921	-12.99%
Average	3.52015	4.11459	-14.26%

Station 5: Gunung Rosa			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.58319	3.16891	13.07%
2	3.60608	3.31345	8.83%
3	3.96488	3.62038	9.52%
4	3.76487	3.54601	6.17%
5	3.63658	3.21225	13.21%
6	3.41959	3.01961	13.25%
7	3.57948	3.20737	11.60%
8	3.81635	3.54677	7.60%
9	4.17897	3.73358	11.93%
10	4.08161	3.97384	2.71%
11	3.81905	3.72874	2.42%
12	3.64309	3.16034	15.28%
Average	3.75781	3.43594	9.63%

Station 7: Karang Anjar			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.28036	4.14165	3.35%
2	4.45872	4.27654	4.26%
3	4.64036	4.17657	11.10%
4	4.49893	4.18971	7.38%
5	4.41914	3.68282	19.99%
6	4.09178	3.37973	21.07%
7	4.33262	3.32724	30.22%
8	4.57995	3.52164	30.05%
9	4.96716	3.69025	34.60%
10	4.84461	3.77727	28.26%
11	4.45462	4.14278	7.53%
12	4.49957	4.06819	10.60%
Average	4.50565	3.86453	17.37%

Appendix IV.a: Method 1 with linear interpolation

Station 9: Lembang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.93329	3.41705	15.11%
2	3.98921	3.40737	17.08%
3	4.01361	3.30112	21.58%
4	3.75471	3.07731	22.01%
5	3.50398	2.81508	24.47%
6	3.31601	2.74241	20.92%
7	3.52631	2.80354	25.78%
8	3.97265	3.30604	20.16%
9	4.36931	3.60768	21.11%
10	4.27709	3.64183	17.44%
11	4.01416	3.54101	13.36%
12	4.01496	3.29878	21.71%
Average	3.89044	3.24660	20.06%

Station 10: Magelang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.20739	3.83196	9.80%
2	4.30772	4.09638	5.16%
3	4.32249	4.13816	4.45%
4	4.47339	3.96610	12.79%
5	3.93187	3.74301	5.05%
6	3.93572	3.50166	12.40%
7	4.12264	3.73075	10.50%
8	4.33093	3.95663	9.46%
9	4.84927	4.58019	5.87%
10	5.00630	4.63427	8.03%
11	4.83833	4.41969	9.47%
12	4.28627	4.24199	1.04%
Average	4.38436	4.07007	7.84%

Station 11: Pangerango			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.15233	2.12274	48.50%
2	3.16866	2.20206	43.90%
3	3.07853	2.17997	41.22%
4	2.92353	2.22835	31.20%
5	2.79853	2.40848	16.19%
6	2.82736	2.44614	15.58%
7	2.85699	2.87411	-0.60%
8	3.36417	3.01113	11.72%
9	3.37342	2.97155	13.52%
10	4.06828	2.65754	53.08%
11	3.68031	2.38096	54.57%
12	2.60344	2.16320	20.35%
Average	3.15796	2.47052	29.10%

Station 12: Pasuruan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.71517	4.38647	-15.30%
2	3.73192	4.46590	-16.44%
3	3.59361	4.48255	-19.83%
4	3.41418	4.45757	-23.41%
5	3.17503	4.07884	-22.16%
6	3.01390	3.96522	-23.99%
7	3.15128	4.25883	-26.01%
8	3.62696	4.92080	-26.29%
9	4.15240	5.54000	-25.05%
10	4.39608	5.70686	-22.97%
11	3.93139	5.35168	-26.54%
12	3.76455	4.61289	-18.39%
Average	3.63887	4.68563	-22.20%

Station 13: Rarahan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.24643	3.09448	-27.41%
2	2.31975	3.10684	-25.33%
3	2.29434	2.93410	-21.80%
4	2.31903	2.77600	-16.46%
5	2.45814	2.66613	-7.80%
6	2.48377	2.72927	-9.00%
7	2.87946	2.73240	5.38%
8	3.04957	3.27855	-6.98%
9	3.04273	3.20465	-5.05%
10	2.76003	4.04602	-31.78%
11	2.49729	3.63788	-31.35%
12	2.27621	2.41620	-5.79%
Average	2.55223	3.05188	-15.28%

Station 14: Sawahan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.28732	3.94767	8.60%
2	4.25377	4.15925	2.27%
3	4.36062	4.37429	-0.31%
4	4.36202	4.34723	0.34%
5	3.97710	3.90028	1.97%
6	3.97624	3.74752	6.10%
7	4.08172	3.87064	5.45%
8	4.57663	4.41258	3.72%
9	5.11499	4.94154	3.51%
10	5.30532	5.22501	1.54%
11	5.00982	4.88532	2.55%
12	4.29063	4.42925	-3.13%
Average	4.46635	4.35338	2.72%

Appendix IV.a: Method 1 with linear interpolation

Station 15: Semarang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.00652	4.23714	-5.44%
2	4.18899	4.14283	1.11%
3	4.37325	4.35758	0.36%
4	4.30980	4.36476	-1.26%
5	3.90815	3.97621	-1.71%
6	3.73500	4.01456	-6.96%
7	3.87318	4.03177	-3.93%
8	4.42910	4.52942	-2.21%
9	4.95560	5.00873	-1.06%
10	5.19423	5.15824	0.70%
11	4.84731	4.94127	-1.90%
12	4.40837	4.12733	6.81%
Average	4.35246	4.40749	-1.29%

Station 20: Tosari			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.29599	2.94762	45.74%
2	4.41234	2.93967	50.10%
3	4.41307	2.76682	59.50%
4	4.33347	2.60877	66.11%
5	3.85587	2.41482	59.68%
6	3.69239	2.31070	59.80%
7	3.87751	2.41289	60.70%
8	4.37986	2.65226	65.14%
9	5.04611	3.05550	65.15%
10	5.28251	3.22448	63.83%
11	5.02490	2.70463	85.79%
12	4.47056	2.85538	56.57%
Average	4.42372	2.74113	61.51%

Station 22: Yogyakarta			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.89687	4.21943	-7.64%
2	4.12301	4.43123	-6.96%
3	4.19775	4.36958	-3.93%
4	4.11695	4.68131	-12.06%
5	3.97773	4.02248	-1.11%
6	3.71061	4.15125	-10.61%
7	3.95688	4.56500	-13.32%
8	4.22853	4.58956	-7.87%
9	4.56342	5.30178	-13.93%
10	4.58838	5.49744	-16.54%
11	4.09850	5.10514	-19.72%
12	4.05407	4.49576	-9.82%
Average	4.12606	4.61916	-10.29%

Station 24: Tegal			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.93496	4.61359	-14.71%
2	3.89328	4.17386	-6.72%
3	4.00547	4.99149	-19.75%
4	3.92244	4.84176	-18.99%
5	3.58137	5.13482	-30.25%
6	3.55653	4.97917	-28.57%
7	3.60091	5.25463	-31.47%
8	4.09953	5.80195	-29.34%
9	4.51673	6.49331	-30.44%
10	4.61431	6.08880	-24.22%
11	4.42991	5.15653	-14.09%
12	3.85126	5.13320	-24.97%
Average	4.00056	5.22193	-22.79%

Appendix IV.b: Method 1 with cubic interpolation

Station 1: Bandung			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.39018	3.89849	-13.04%
2	3.40213	3.97067	-14.32%
3	3.28184	3.93573	-16.61%
4	3.06229	3.66145	-16.36%
5	2.78860	3.38944	-17.73%
6	2.70817	3.20428	-15.48%
7	2.76966	3.41575	-18.92%
8	3.25609	3.85352	-15.50%
9	3.53003	4.23098	-16.57%
10	3.58365	4.14705	-13.59%
11	3.49738	3.91990	-10.78%
12	3.24735	3.94828	-17.75%
Average	3.20978	3.79796	-15.55%

Station 2: Bogor			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.56189	3.63145	-1.92%
2	3.67080	3.76544	-2.51%
3	3.74488	3.99283	-6.21%
4	3.70881	4.01561	-7.64%
5	3.48071	3.68994	-5.67%
6	3.36207	3.59839	-6.57%
7	3.67997	3.82450	-3.78%
8	4.05884	4.28039	-5.18%
9	4.38284	4.81245	-8.93%
10	4.17020	4.73173	-11.87%
11	3.95878	4.32243	-8.41%
12	3.60877	3.88899	-7.21%
Average	3.78238	4.04618	-6.32%

Appendix IV.b: Method 1 with cubic interpolation

Station 3: Curug-Budiarto			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.93057	4.52963	-13.23%
2	4.03925	4.65777	-13.28%
3	4.35646	4.76328	-8.54%
4	4.27196	4.68849	-8.88%
5	3.94686	4.21887	-6.45%
6	3.77388	4.02395	-6.21%
7	3.95568	4.27544	-7.48%
8	4.43421	4.84760	-8.53%
9	4.89588	5.36224	-8.70%
10	4.87927	5.26973	-7.41%
11	4.54283	5.05208	-10.08%
12	4.14106	4.56378	-9.26%
Average	4.26399	4.68774	-9.00%

Station 4: Djember			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.46523	4.23659	-18.21%
2	3.61227	4.35606	-17.07%
3	3.52994	4.36241	-19.08%
4	3.39803	4.10308	-17.18%
5	2.95403	3.59263	-17.78%
6	2.80421	3.28643	-14.67%
7	2.83897	3.29496	-13.84%
8	3.10556	3.80521	-18.39%
9	3.62503	4.50034	-19.45%
10	3.92134	4.81514	-18.56%
11	3.65324	4.69302	-22.16%
12	3.60403	4.32921	-16.75%
Average	3.37599	4.11459	-17.76%

Station 5: Gunung Rosa			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.48900	3.16891	10.10%
2	3.53317	3.31345	6.63%
3	3.84494	3.62038	6.20%
4	3.65218	3.54601	2.99%
5	3.51883	3.21225	9.54%
6	3.30855	3.01961	9.57%
7	3.47534	3.20737	8.35%
8	3.70956	3.54677	4.59%
9	4.08979	3.73358	9.54%
10	3.95938	3.97384	-0.36%
11	3.71276	3.72874	-0.43%
12	3.56780	3.16034	12.89%
Average	3.65511	3.43594	6.64%

Station 7: Karang Anjar			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.33149	4.14165	4.58%
2	4.49787	4.27654	5.18%
3	4.67595	4.17657	11.96%
4	4.54577	4.18971	8.50%
5	4.46029	3.68282	21.11%
6	4.15154	3.37973	22.84%
7	4.41708	3.32724	32.76%
8	4.64593	3.52164	31.93%
9	5.08302	3.69025	37.74%
10	4.94575	3.77727	30.93%
11	4.54905	4.14278	9.81%
12	4.58970	4.06819	12.82%
Average	4.57445	3.86453	19.18%

Station 9: Lembang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.93382	3.41705	15.12%
2	3.98568	3.40737	16.97%
3	3.97612	3.30112	20.45%
4	3.69972	3.07731	20.23%
5	3.44059	2.81508	22.22%
6	3.25930	2.74241	18.85%
7	3.47261	2.80354	23.87%
8	3.92440	3.30604	18.70%
9	4.33138	3.60768	20.06%
10	4.22718	3.64183	16.07%
11	3.97964	3.54101	12.39%
12	4.01438	3.29878	21.69%
Average	3.85374	3.24660	18.88%

Station 10: Magelang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.23908	3.83196	10.62%
2	4.31180	4.09638	5.26%
3	4.35784	4.13816	5.31%
4	4.55160	3.96610	14.76%
5	3.95626	3.74301	5.70%
6	4.02070	3.50166	14.82%
7	4.21745	3.73075	13.05%
8	4.36894	3.95663	10.42%
9	4.97083	4.58019	8.53%
10	5.11938	4.63427	10.47%
11	4.98578	4.41969	12.81%
12	4.38128	4.24199	3.28%
Average	4.45675	4.07007	9.59%

Appendix IV.b: Method 1 with cubic interpolation

Station 11: Pangerango			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.09458	2.12274	45.78%
2	3.11301	2.20206	41.37%
3	2.97817	2.17997	36.62%
4	2.83162	2.22835	27.07%
5	2.71446	2.40848	12.70%
6	2.76863	2.44614	13.18%
7	2.78456	2.87411	-3.12%
8	3.31471	3.01113	10.08%
9	3.26956	2.97155	10.03%
10	4.06943	2.65754	53.13%
11	3.65814	2.38096	53.64%
12	2.46412	2.16320	13.91%
Average	3.08842	2.47052	26.20%

Station 12: Pasuruan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.53787	4.38647	-19.35%
2	3.52396	4.46590	-21.09%
3	3.40426	4.48255	-24.06%
4	3.19861	4.45757	-28.24%
5	2.97916	4.07884	-26.96%
6	2.82518	3.96522	-28.75%
7	2.91655	4.25883	-31.52%
8	3.33956	4.92080	-32.13%
9	3.84014	5.54000	-30.68%
10	4.04358	5.70686	-29.15%
11	3.61987	5.35168	-32.36%
12	3.54912	4.61289	-23.06%
Average	3.39816	4.68563	-27.28%

Station 13: Rarahan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.14885	3.09448	-30.56%
2	2.22594	3.10684	-28.35%
3	2.18321	2.93410	-25.59%
4	2.21927	2.77600	-20.06%
5	2.38978	2.66613	-10.37%
6	2.42532	2.72927	-11.14%
7	2.84194	2.73240	4.01%
8	2.99300	3.27855	-8.71%
9	2.95079	3.20465	-7.92%
10	2.64791	4.04602	-34.56%
11	2.38514	3.63788	-34.44%
12	2.17485	2.41620	-9.99%
Average	2.46550	3.05188	-18.14%

Station 14: Sawahan			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.28309	3.94767	8.50%
2	4.23853	4.15925	1.91%
3	4.35570	4.37429	-0.42%
4	4.38669	4.34723	0.91%
5	3.95757	3.90028	1.47%
6	4.00839	3.74752	6.96%
7	4.09115	3.87064	5.70%
8	4.56784	4.41258	3.52%
9	5.10400	4.94154	3.29%
10	5.29957	5.22501	1.43%
11	5.05159	4.88532	3.40%
12	4.22989	4.42925	-4.50%
Average	4.46450	4.35338	2.68%

Station 15: Semarang			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.02200	4.23714	-5.08%
2	4.23389	4.14283	2.20%
3	4.48832	4.35758	3.00%
4	4.44175	4.36476	1.76%
5	4.01359	3.97621	0.94%
6	3.83672	4.01456	-4.43%
7	3.96026	4.03177	-1.77%
8	4.52690	4.52942	-0.06%
9	5.05888	5.00873	1.00%
10	5.31047	5.15824	2.95%
11	4.98422	4.94127	0.87%
12	4.52182	4.12733	9.56%
Average	4.44990	4.40749	0.91%

Station 20: Tosari			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.34601	2.94762	47.44%
2	4.46250	2.93967	51.80%
3	4.45625	2.76682	61.06%
4	4.43051	2.60877	69.83%
5	3.96287	2.41482	64.11%
6	3.84659	2.31070	66.47%
7	4.11381	2.41289	70.49%
8	4.64854	2.65226	75.27%
9	5.31116	3.05550	73.82%
10	5.49557	3.22448	70.43%
11	5.19507	2.70463	92.08%
12	4.52057	2.85538	58.32%
Average	4.56579	2.74113	66.76%

Appendix IV.b: Method 1 with cubic interpolation

Station 22: Yogyakarta			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.82443	4.21943	-9.36%
2	4.10820	4.43123	-7.29%
3	4.15981	4.36958	-4.80%
4	4.05980	4.68131	-13.28%
5	3.92284	4.02248	-2.48%
6	3.65610	4.15125	-11.93%
7	3.93453	4.56500	-13.81%
8	4.17079	4.58956	-9.12%
9	4.60720	5.30178	-13.10%
10	4.64679	5.49744	-15.47%
11	4.19754	5.10514	-17.78%
12	4.10164	4.49576	-8.77%
Average	4.11581	4.61916	-10.60%

Station 24: Tegal			
Month	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.90685	4.61359	-15.32%
2	3.82153	4.17386	-8.44%
3	3.91907	4.99149	-21.48%
4	3.85627	4.84176	-20.35%
5	3.47615	5.13482	-32.30%
6	3.48549	4.97917	-30.00%
7	3.48264	5.25463	-33.72%
8	3.97570	5.80195	-31.48%
9	4.37767	6.49331	-32.58%
10	4.45666	6.08880	-26.81%
11	4.36475	5.15653	-15.35%
12	3.75916	5.13320	-26.77%
Average	3.90683	5.22193	-24.55%

Appendix IV.c: Method 2 with linear interpolation

Station 1: Bandung								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.99829	3.46523	0.25780	0.39418	1.09915	3.28166	3.89849	-15.82%
2	2.98188	3.53646	0.27245	0.39504	1.09915	3.28134	3.97067	-17.36%
3	2.98651	3.52333	0.24654	0.37520	1.09915	3.25749	3.93573	-17.23%
4	2.78460	3.29837	0.24439	0.33032	1.09915	3.05323	3.66145	-16.61%
5	2.57048	3.05002	0.20721	0.30880	1.09915	2.79824	3.38944	-17.44%
6	2.45669	2.86700	0.21799	0.30685	1.09915	2.69629	3.20428	-15.85%
7	2.55915	3.05336	0.20252	0.32970	1.09915	2.78175	3.41575	-18.56%
8	2.92986	3.38740	0.27904	0.42407	1.09915	3.23657	3.85352	-16.01%
9	3.17601	3.67753	0.30078	0.50353	1.09915	3.50661	4.23098	-17.12%
10	3.18371	3.70047	0.33460	0.40630	1.09915	3.55148	4.14705	-14.36%
11	3.09313	3.53199	0.31162	0.35292	1.09915	3.43564	3.91990	-12.35%
12	2.87272	3.47421	0.27252	0.43130	1.09915	3.17226	3.94828	-19.65%
Average	2.88275	3.38045	0.26229	0.37985	1.09915	3.17105	3.79796	-16.53%

Station 2: Bogor								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.26222	3.29931	0.38483	0.41605	0.79833	3.56945	3.63145	-1.71%
2	3.37123	3.47343	0.35447	0.36577	0.79833	3.65422	3.76544	-2.95%
3	3.46405	3.64111	0.38242	0.38974	0.90246	3.80917	3.99283	-4.60%
4	3.38813	3.60490	0.39233	0.41277	0.99502	3.77851	4.01561	-5.90%
5	3.12143	3.31481	0.40572	0.41568	0.90246	3.48758	3.68994	-5.48%
6	2.96914	3.22554	0.42080	0.41314	0.90246	3.34890	3.59839	-6.93%
7	3.17129	3.36700	0.48281	0.45978	0.99502	3.65169	3.82450	-4.52%
8	3.55855	3.77090	0.48630	0.51204	0.99502	4.04244	4.28039	-5.56%
9	3.91457	4.24801	0.48905	0.56726	0.99502	4.40119	4.81245	-8.55%
10	3.83723	4.11925	0.44000	0.50902	1.20328	4.36668	4.73173	-7.71%
11	3.61741	3.83586	0.44279	0.48900	0.99502	4.05800	4.32243	-6.12%
12	3.29132	3.47058	0.40164	0.46364	0.90246	3.65379	3.88899	-6.05%
Average	3.41388	3.61423	0.42360	0.45116	0.94874	3.81847	4.04618	-5.51%

Appendix IV.c: Method 2 with linear interpolation

Station 3: Curug-Budiarto								
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	3.31556	4.09803	0.35933	0.54063	0.79833	3.60242	4.52963	-20.47%
2	3.44189	4.26585	0.34741	0.49093	0.79833	3.71923	4.65777	-20.15%
3	3.71548	4.34937	0.35927	0.51847	0.79833	4.00230	4.76328	-15.98%
4	3.63690	4.25202	0.36965	0.54674	0.79833	3.93200	4.68849	-16.14%
5	3.40116	3.82202	0.42233	0.49711	0.79833	3.73833	4.21887	-11.39%
6	3.15720	3.61238	0.43748	0.51553	0.79833	3.50646	4.02395	-12.86%
7	3.26938	3.82384	0.41811	0.56569	0.79833	3.60318	4.27544	-15.72%
8	3.69290	4.39430	0.46107	0.56781	0.79833	4.06098	4.84760	-16.23%
9	4.03606	4.88384	0.50466	0.59924	0.79833	4.43894	5.36224	-17.22%
10	4.02216	4.81135	0.49772	0.57418	0.79833	4.41951	5.26973	-16.13%
11	3.75545	4.54576	0.46472	0.63421	0.79833	4.12645	5.05208	-18.32%
12	3.49568	4.10706	0.41170	0.57209	0.79833	3.82435	4.56378	-16.20%
Average	3.57832	4.24715	0.42112	0.55189	0.79833	3.91451	4.68774	-16.40%

Station 4: Djember								
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	3.23297	3.89412	0.42494	0.42898	0.79833	3.57221	4.23659	-15.68%
2	3.42057	4.01305	0.40435	0.42967	0.79833	3.74337	4.35606	-14.07%
3	3.36714	4.01824	0.39828	0.43111	0.79833	3.68510	4.36241	-15.53%
4	3.26618	3.77988	0.36884	0.40484	0.79833	3.56064	4.10308	-13.22%
5	2.80896	3.35122	0.32947	0.30239	0.79833	3.07199	3.59263	-14.49%
6	2.65054	3.04533	0.32843	0.30201	0.79833	2.91274	3.28643	-11.37%
7	2.67445	3.03495	0.32780	0.32570	0.79833	2.93615	3.29496	-10.89%
8	2.93804	3.47920	0.34401	0.40837	0.79833	3.21268	3.80521	-15.57%
9	3.44151	4.12330	0.39797	0.47228	0.79833	3.75922	4.50034	-16.47%
10	3.73759	4.41839	0.42257	0.49697	0.79833	4.07494	4.81514	-15.37%
11	3.50198	4.32205	0.44289	0.46469	0.79833	3.85555	4.69302	-17.85%
12	3.36954	3.98574	0.48982	0.43024	0.79833	3.76057	4.32921	-13.13%
Average	3.20079	3.78879	0.38995	0.40810	0.79833	3.51210	4.11459	-14.47%

Station 5: Gunung Rosa								
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	3.03590	2.67656	0.38448	0.32734	1.50410	3.61420	3.16891	14.05%
2	3.04907	2.81466	0.34625	0.33162	1.50410	3.56986	3.31345	7.74%
3	3.42483	3.06090	0.39270	0.37197	1.50410	4.01550	3.62038	10.91%
4	3.24280	3.01552	0.35338	0.35270	1.50410	3.77432	3.54601	6.44%
5	3.04820	2.74005	0.39079	0.31394	1.50410	3.63600	3.21225	13.19%
6	2.86568	2.61123	0.35203	0.27152	1.50410	3.39517	3.01961	12.44%
7	2.98492	2.76997	0.38855	0.29081	1.50410	3.56934	3.20737	11.29%
8	3.22902	3.01709	0.43890	0.35216	1.50410	3.88917	3.54677	9.65%
9	3.54585	3.17330	0.47892	0.37250	1.50410	4.26619	3.73358	14.27%
10	3.51397	3.37934	0.45454	0.39525	1.50410	4.19764	3.97384	5.63%
11	3.33419	3.16641	0.38674	0.37387	1.50410	3.91589	3.72874	5.02%
12	3.08891	2.66634	0.38335	0.32844	1.50410	3.66551	3.16034	15.98%
Average	3.19695	2.92428	0.39589	0.34018	1.50410	3.79240	3.43594	10.55%

Station 7: Karang Anjar								
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	3.11816	3.85813	0.37257	0.35514	0.79833	3.41560	4.14165	-17.53%
2	3.15011	3.94922	0.40032	0.41001	0.79833	3.46969	4.27654	-18.87%
3	3.51166	3.86970	0.40117	0.38438	0.79833	3.83193	4.17657	-8.25%
4	3.30486	3.92596	0.40542	0.33038	0.79833	3.62851	4.18971	-13.39%
5	3.10590	3.48193	0.40047	0.25165	0.79833	3.42560	3.68282	-6.98%
6	2.78553	3.22109	0.38826	0.19872	0.79833	3.09549	3.37973	-8.41%
7	2.98749	3.17000	0.39048	0.19696	0.79833	3.29922	3.32724	-0.84%
8	3.36948	3.34439	0.40508	0.22204	0.79833	3.69286	3.52164	4.86%
9	3.65868	3.45191	0.43648	0.29855	0.79833	4.00713	3.69025	8.59%
10	3.72231	3.53730	0.41718	0.30059	0.79833	4.05536	3.77727	7.36%
11	3.45908	3.86171	0.39445	0.35207	0.79833	3.77398	4.14278	-8.90%
12	3.28801	3.76684	0.38774	0.37748	0.79833	3.59755	4.06819	-11.57%
Average	3.28844	3.61985	0.39997	0.30650	0.79833	3.60774	3.86453	-6.16%

Appendix IV.c: Method 2 with linear interpolation

Station 9: Lembang								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.44960	3.05030	0.38683	0.24383	1.50410	4.03143	3.41705	17.98%
2	3.50944	3.01503	0.38599	0.26085	1.50410	4.09001	3.40737	20.03%
3	3.55624	2.96402	0.37151	0.22412	1.50410	4.11503	3.30112	24.66%
4	3.32573	2.74129	0.33502	0.22341	1.50410	3.82963	3.07731	24.45%
5	3.08699	2.53605	0.32346	0.18551	1.50410	3.57350	2.81508	26.94%
6	2.88798	2.43641	0.32572	0.20344	1.50410	3.37789	2.74241	23.17%
7	3.07614	2.52758	0.34420	0.18347	1.50410	3.59384	2.80354	28.19%
8	3.41564	2.90970	0.43196	0.26350	1.50410	4.06535	3.30604	22.97%
9	3.70979	3.17504	0.50627	0.28764	1.50410	4.47127	3.60768	23.94%
10	3.73530	3.15366	0.41885	0.32456	1.50410	4.36528	3.64183	19.87%
11	3.54486	3.08696	0.36567	0.30187	1.50410	4.09486	3.54101	15.64%
12	3.47968	2.90463	0.42808	0.26205	1.50410	4.12356	3.29878	25.00%
Average	3.39812	2.87506	0.38530	0.24702	1.50410	3.97764	3.24660	22.74%

Station 10: Magelang								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.27586	3.52117	0.37473	0.38930	0.79833	3.57501	3.83196	-6.71%
2	3.37012	3.72436	0.39565	0.46600	0.79833	3.68598	4.09638	-10.02%
3	3.48284	3.78627	0.40476	0.44078	0.79833	3.80597	4.13816	-8.03%
4	3.45075	3.63280	0.41031	0.41750	0.79833	3.77831	3.96610	-4.73%
5	3.17279	3.41184	0.37420	0.41483	0.79833	3.47153	3.74301	-7.25%
6	2.99529	3.21146	0.39958	0.36351	0.79833	3.31429	3.50166	-5.35%
7	3.01388	3.42128	0.41601	0.38764	0.79833	3.34599	3.73075	-10.31%
8	3.27462	3.66365	0.40292	0.36699	0.79833	3.59628	3.95663	-9.11%
9	3.54933	4.20139	0.44984	0.47449	0.79833	3.90845	4.58019	-14.67%
10	3.61509	4.28084	0.44815	0.44271	0.79833	3.97286	4.63427	-14.27%
11	3.69954	4.06501	0.42743	0.44428	0.79833	4.04076	4.41969	-8.57%
12	3.33835	3.89229	0.39078	0.43804	0.79833	3.65032	4.24199	-13.95%
Average	3.35321	3.73436	0.40786	0.42051	0.79833	3.67881	4.07007	-9.41%

Station 11: Pangerango								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.91693	1.90581	0.29487	0.10838	2.00161	3.50715	2.12274	65.22%
2	2.88920	1.95985	0.35005	0.12101	2.00161	3.58986	2.20206	63.02%
3	2.82668	1.91211	0.31288	0.13382	2.00161	3.45295	2.17997	58.39%
4	2.67216	1.93285	0.30970	0.14763	2.00161	3.29206	2.22835	47.74%
5	2.51869	1.90638	0.34778	0.25085	2.00161	3.21481	2.40848	33.48%
6	2.52829	1.84720	0.37188	0.29923	2.00161	3.27264	2.44614	33.79%
7	2.48967	2.09233	0.45435	0.39058	2.00161	3.39910	2.87411	18.27%
8	3.06547	2.27431	0.36774	0.36812	2.00161	3.80153	3.01113	26.25%
9	3.00106	2.39046	0.45932	0.29031	2.00161	3.92044	2.97155	31.93%
10	3.68112	2.28787	0.47183	0.18469	2.00161	4.62554	2.65754	74.05%
11	3.38333	2.11511	0.36587	0.13282	2.00161	4.11566	2.38096	72.86%
12	2.33570	1.94685	0.33230	0.10809	2.00161	3.00083	2.16320	38.72%
Average	2.85903	2.04759	0.36988	0.21129	2.00161	3.59938	2.47052	46.98%

Station 12: Pasuruan								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.08826	3.88420	0.37169	0.50478	0.99502	3.45809	4.38647	-21.16%
2	3.24291	3.89871	0.36141	0.47138	1.20328	3.67778	4.46590	-17.65%
3	3.12407	4.07068	0.35353	0.45638	0.90246	3.44312	4.48255	-23.19%
4	3.04605	3.95293	0.32779	0.41939	1.20328	3.44047	4.45757	-22.82%
5	2.77588	3.53940	0.29827	0.41629	1.29584	3.16239	4.07884	-22.47%
6	2.60650	3.35490	0.31130	0.43596	1.39997	3.04230	3.96522	-23.28%
7	2.69218	3.38687	0.33347	0.54611	1.59666	3.22462	4.25883	-24.28%
8	2.96986	3.76741	0.38256	0.63903	1.80492	3.66036	4.92080	-25.61%
9	3.42569	4.17481	0.43228	0.65190	2.09417	4.33095	5.54000	-21.82%
10	3.70693	4.42967	0.48157	0.67310	1.89748	4.62070	5.70686	-19.03%
11	3.43080	4.38168	0.43478	0.64491	1.50410	4.08475	5.35168	-23.67%
12	3.26490	3.97893	0.40770	0.52686	1.20328	3.75548	4.61289	-18.59%
Average	3.11450	3.90168	0.37470	0.53217	1.42504	3.65842	4.68563	-21.96%

Appendix IV.c: Method 2 with linear interpolation

Station 13: Rarahan

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.01765	2.87453	0.12200	0.27551	0.79833	2.11504	3.09448	-31.65%
2	2.06596	2.82733	0.13481	0.35012	0.79833	2.17358	3.10684	-30.04%
3	2.02160	2.69672	0.14359	0.29735	0.79833	2.13623	2.93410	-27.19%
4	2.02123	2.53752	0.15611	0.29873	0.79833	2.14586	2.77600	-22.70%
5	1.97650	2.39669	0.24783	0.33751	0.79833	2.17435	2.66613	-18.45%
6	1.91180	2.43159	0.29350	0.37287	0.79833	2.14611	2.72927	-21.37%
7	2.14401	2.36357	0.37436	0.46200	0.79833	2.44288	2.73240	-10.60%
8	2.34430	2.99984	0.36056	0.34911	0.79833	2.63214	3.27855	-19.72%
9	2.47563	2.84700	0.29240	0.44800	0.79833	2.70906	3.20465	-15.46%
10	2.38127	3.67102	0.19936	0.46972	0.79833	2.54043	4.04602	-37.21%
11	2.21632	3.35493	0.15012	0.35444	0.79833	2.33617	3.63788	-35.78%
12	2.04539	2.16321	0.12382	0.31690	0.79833	2.14424	2.41620	-11.26%
Average	2.13514	2.76366	0.21654	0.36102	0.79833	2.30801	3.05188	-23.45%

Station 14: Sawahan

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.50520	3.66307	0.48432	0.35650	0.79833	3.89185	3.94767	-1.41%
2	3.58326	3.85427	0.47230	0.38202	0.79833	3.96031	4.15925	-4.78%
3	3.73631	4.08825	0.49728	0.35830	0.79833	4.13331	4.37429	-5.51%
4	3.68153	4.05929	0.48492	0.36067	0.79833	4.06865	4.34723	-6.41%
5	3.35642	3.61351	0.45184	0.35921	0.79833	3.71714	3.90028	-4.70%
6	3.30846	3.46188	0.46131	0.35780	0.79833	3.67674	3.74752	-1.89%
7	3.40553	3.56132	0.44025	0.38745	0.79833	3.75699	3.87064	-2.94%
8	3.84221	4.03224	0.45931	0.47642	0.79833	4.20889	4.41258	-4.62%
9	4.29718	4.50988	0.47937	0.54071	0.79833	4.67988	4.94154	-5.30%
10	4.43013	4.75083	0.53037	0.59396	0.79833	4.85354	5.22501	-7.11%
11	4.24312	4.45930	0.52852	0.53364	0.79833	4.66505	4.88532	-4.51%
12	3.59725	4.05453	0.48019	0.46939	0.79833	3.98060	4.42925	-10.13%
Average	3.74888	4.00903	0.48083	0.43134	0.79833	4.13275	4.35338	-4.94%

Station 15: Semarang

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.64116	3.68185	0.35883	0.55806	0.99502	3.99821	4.23714	-5.64%
2	3.84549	3.65927	0.37617	0.53583	0.90246	4.18496	4.14283	1.02%
3	4.04626	3.90165	0.36022	0.57110	0.79833	4.33383	4.35758	-0.55%
4	4.00461	3.82066	0.36090	0.54682	0.99502	4.36371	4.36476	-0.02%
5	3.58656	3.45681	0.36588	0.52200	0.99502	3.95062	3.97621	-0.64%
6	3.41277	3.49354	0.36840	0.52363	0.99502	3.77934	4.01456	-5.86%
7	3.52892	3.60246	0.38203	0.47571	0.90246	3.87369	4.03177	-3.92%
8	3.96639	4.13985	0.45817	0.48798	0.79833	4.33216	4.52942	-4.36%
9	4.43723	4.61170	0.51757	0.49733	0.79833	4.85042	5.00873	-3.16%
10	4.66527	4.66559	0.56852	0.54590	0.90246	5.17833	5.15824	0.39%
11	4.40486	4.38737	0.52119	0.55667	0.99502	4.92345	4.94127	-0.36%
12	4.00807	3.61556	0.45883	0.51433	0.99502	4.46462	4.12733	8.17%
Average	3.96230	3.91969	0.42473	0.52795	0.92271	4.35278	4.40749	-1.24%

Station 20: Tosari

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.72070	2.66435	0.43624	0.35483	0.79833	4.06897	2.94762	38.04%
2	3.80432	2.67007	0.42754	0.33770	0.79833	4.14564	2.93967	41.02%
3	3.89504	2.51205	0.42324	0.31913	0.79833	4.23293	2.76682	52.99%
4	3.73496	2.38418	0.40418	0.28133	0.79833	4.05762	2.60877	55.54%
5	3.35426	2.17787	0.35429	0.29680	0.79833	3.63710	2.41482	50.62%
6	3.10249	2.04940	0.37368	0.32731	0.79833	3.40080	2.31070	47.18%
7	3.11004	2.12819	0.43944	0.35662	0.79833	3.46086	2.41289	43.43%
8	3.48090	2.35278	0.50734	0.37513	0.79833	3.88592	2.65226	46.51%
9	3.96643	2.70706	0.54923	0.43645	0.79833	4.40490	3.05550	44.16%
10	4.21135	2.87153	0.56358	0.44210	0.79833	4.66127	3.22448	44.56%
11	4.17915	2.42340	0.52661	0.35227	0.79833	4.59955	2.70463	70.06%
12	3.83243	2.57262	0.45353	0.35419	0.79833	4.19450	2.85538	46.90%
Average	3.69934	2.45946	0.45491	0.35282	0.79833	4.06251	2.74113	48.42%

Appendix IV.c: Method 2 with linear interpolation

Station 22: Yogyakarta

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.98642	2.72862	0.35002	0.26350	5.65773	4.96676	4.21943	17.71%
2	3.07817	2.90131	0.38524	0.29648	5.16022	5.06612	4.43123	14.33%
3	3.27462	3.02116	0.39259	0.30509	4.41974	5.00978	4.36958	14.65%
4	3.13994	2.97874	0.40328	0.35891	4.74370	5.05299	4.68131	7.94%
5	2.90728	2.83719	0.40017	0.33588	3.52885	4.31940	4.02248	7.38%
6	2.63302	2.55880	0.40181	0.41457	3.84124	4.17648	4.15125	0.61%
7	2.82943	2.55146	0.41593	0.48208	4.17677	4.56668	4.56500	0.04%
8	3.25554	2.67167	0.39952	0.43394	4.41974	5.02130	4.58956	9.41%
9	3.55712	2.89705	0.41655	0.49135	4.89411	5.59575	5.30178	5.54%
10	3.69211	2.96120	0.41155	0.45479	5.57674	5.98724	5.49744	8.91%
11	3.33705	3.16888	0.36544	0.37862	5.11394	5.20589	5.10514	1.97%
12	3.09639	2.94982	0.37334	0.31588	4.89411	4.92357	4.49576	9.52%
Average	3.14892	2.85216	0.39295	0.37759	4.70224	4.99100	4.61916	8.17%

Station 24: Tegal

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.47413	2.72279	0.43432	0.28924	6.53705	6.31332	4.61359	36.84%
2	3.46508	2.38747	0.42713	0.25605	6.97671	6.44503	4.17386	54.41%
3	3.61139	3.27721	0.43542	0.31864	5.38005	5.95398	4.99149	19.28%
4	3.47807	2.78924	0.42143	0.38819	5.28749	5.70640	4.84176	17.86%
5	3.16598	2.95453	0.40161	0.43621	4.99824	5.17332	5.13482	0.75%
6	3.12991	2.53242	0.41066	0.48952	4.99824	5.18247	4.97917	4.08%
7	3.23981	2.76210	0.37170	0.53062	4.69742	4.98583	5.25463	-5.12%
8	3.71184	3.12887	0.40765	0.58788	4.54701	5.56541	5.80195	-4.08%
9	4.10843	3.33120	0.42632	0.58775	5.38005	6.40203	6.49331	-1.41%
10	4.13695	3.36634	0.46698	0.55106	4.94039	6.44403	6.08880	5.83%
11	3.93444	2.79679	0.46328	0.45832	5.14865	6.31969	5.15653	22.56%
12	3.40313	2.95053	0.42045	0.38977	5.59988	5.75758	5.13320	12.16%
Average	3.57160	2.91662	0.42391	0.44027	5.37427	5.85409	5.22193	13.60%

Appendix IV.d: Method 2 with cubic interpolation

Station 1: Bandung

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.02226	3.46523	0.24712	0.39418	1.09915	3.29388	3.89849	-15.51%
2	2.99730	3.53646	0.26516	0.39504	1.09915	3.28874	3.97067	-17.17%
3	2.93704	3.52333	0.22871	0.37520	1.09915	3.18843	3.93573	-18.99%
4	2.72811	3.29837	0.22530	0.33032	1.09915	2.97575	3.66145	-18.73%
5	2.51168	3.05002	0.18257	0.30880	1.09915	2.71235	3.38944	-19.98%
6	2.41704	2.86700	0.19653	0.30685	1.09915	2.63306	3.20428	-17.83%
7	2.50569	3.05336	0.17740	0.32970	1.09915	2.70068	3.41575	-20.93%
8	2.88753	3.38740	0.25692	0.42407	1.09915	3.16993	3.85352	-17.74%
9	3.13974	3.67753	0.27976	0.50353	1.09915	3.44723	4.23098	-18.52%
10	3.12979	3.70047	0.31810	0.40630	1.09915	3.47943	4.14705	-16.10%
11	3.07143	3.53199	0.29694	0.35292	1.09915	3.39781	3.91990	-13.32%
12	2.86223	3.47421	0.25961	0.43130	1.09915	3.14758	3.94828	-20.28%
Average	2.85082	3.38045	0.24451	0.37985	1.09915	3.11957	3.79796	-17.92%

Station 2: Bogor

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.29104	3.29931	0.39379	0.41605	0.79833	3.60542	3.63145	-0.72%
2	3.42172	3.47343	0.35745	0.36577	0.79833	3.70708	3.76544	-1.55%
3	3.46657	3.64111	0.38953	0.38974	0.90246	3.81810	3.99283	-4.38%
4	3.40869	3.60490	0.40504	0.41277	0.99502	3.81171	4.01561	-5.08%
5	3.11399	3.31481	0.40441	0.41568	0.90246	3.47895	3.68994	-5.72%
6	2.97581	3.22554	0.42235	0.41314	0.90246	3.35697	3.59839	-6.71%
7	3.21557	3.36700	0.49697	0.45978	0.99502	3.71006	3.82450	-2.99%
8	3.59766	3.77090	0.49708	0.51204	0.99502	4.09227	4.28039	-4.39%
9	3.98204	4.24801	0.48694	0.56726	0.99502	4.46656	4.81245	-7.19%
10	3.85988	4.11925	0.42712	0.50902	1.20328	4.37382	4.73173	-7.56%
11	3.64661	3.83586	0.44910	0.48900	0.99502	4.09348	4.32243	-5.30%
12	3.32715	3.47058	0.40598	0.46364	0.90246	3.69353	3.88899	-5.03%
Average	3.44223	3.61423	0.42798	0.45116	0.94874	3.85066	4.04618	-4.72%

Appendix IV.d: Method 2 with cubic interpolation

Station 3: Curug-Budiarto

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.45966	4.09803	0.36852	0.54063	0.79833	3.75386	4.52963	-17.13%
2	3.58152	4.26585	0.35626	0.49093	0.79833	3.86594	4.65777	-17.00%
3	3.86297	4.34937	0.36686	0.51847	0.79833	4.15584	4.76328	-12.75%
4	3.75569	4.25202	0.37810	0.54674	0.79833	4.05754	4.68849	-13.46%
5	3.47164	3.82202	0.43373	0.49711	0.79833	3.81790	4.21887	-9.50%
6	3.24236	3.61238	0.45210	0.51553	0.79833	3.60329	4.02395	-10.45%
7	3.38106	3.82384	0.42596	0.56569	0.79833	3.72112	4.27544	-12.97%
8	3.80889	4.39430	0.46132	0.56781	0.79833	4.17718	4.84760	-13.83%
9	4.17813	4.88384	0.51027	0.59924	0.79833	4.58549	5.36224	-14.49%
10	4.16565	4.81135	0.50035	0.57418	0.79833	4.56510	5.26973	-13.37%
11	3.89711	4.54576	0.47102	0.63421	0.79833	4.27313	5.05208	-15.42%
12	3.60747	4.10706	0.41897	0.57209	0.79833	3.94195	4.56378	-13.63%
Average	3.70101	4.24715	0.42862	0.55189	0.79833	4.04320	4.68774	-13.67%

Station 4: Djember

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.14004	3.89412	0.41911	0.42898	0.79833	3.47463	4.23659	-17.99%
2	3.30199	4.01305	0.39724	0.42967	0.79833	3.61911	4.35606	-16.92%
3	3.22273	4.01824	0.39031	0.43111	0.79833	3.53432	4.36241	-18.98%
4	3.11554	3.77988	0.35809	0.40484	0.79833	3.40142	4.10308	-17.10%
5	2.69226	3.35122	0.32624	0.30239	0.79833	2.95271	3.59263	-17.81%
6	2.53916	3.04533	0.33007	0.30201	0.79833	2.80266	3.28643	-14.72%
7	2.57113	3.03495	0.33379	0.32570	0.79833	2.83760	3.29496	-13.88%
8	2.82865	3.47920	0.34807	0.40837	0.79833	3.10652	3.80521	-18.36%
9	3.31025	4.12330	0.40175	0.47228	0.79833	3.63098	4.50034	-19.32%
10	3.58964	4.41839	0.42278	0.49697	0.79833	3.92716	4.81514	-18.44%
11	3.31744	4.32205	0.42946	0.46469	0.79833	3.66030	4.69302	-22.01%
12	3.23150	3.98574	0.47314	0.43024	0.79833	3.60922	4.32921	-16.63%
Average	3.07169	3.78879	0.38584	0.40810	0.79833	3.37972	4.11459	-17.68%

Station 5: Gunung Rosa

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.10617	2.67656	0.38653	0.32734	1.50410	3.68756	3.16891	16.37%
2	3.14245	2.81466	0.34508	0.33162	1.50410	3.66149	3.31345	10.50%
3	3.47427	3.06090	0.38982	0.37197	1.50410	4.06059	3.62038	12.16%
4	3.28965	3.01552	0.34939	0.35270	1.50410	3.81517	3.54601	7.59%
5	3.06401	2.74005	0.38456	0.31394	1.50410	3.64243	3.21225	13.39%
6	2.90791	2.61123	0.34653	0.27152	1.50410	3.42912	3.01961	13.56%
7	3.05499	2.76997	0.38892	0.29081	1.50410	3.63997	3.20737	13.49%
8	3.27239	3.01709	0.44067	0.35216	1.50410	3.93520	3.54677	10.95%
9	3.62945	3.17330	0.48509	0.37250	1.50410	4.35906	3.73358	16.75%
10	3.57238	3.37934	0.44602	0.39525	1.50410	4.24324	3.97384	6.78%
11	3.41084	3.16641	0.38287	0.37387	1.50410	3.98671	3.72874	6.92%
12	3.17313	2.66634	0.38676	0.32844	1.50410	3.75485	3.16034	18.81%
Average	3.25814	2.92428	0.39435	0.34018	1.50410	3.85128	3.43594	12.27%

Station 7: Karang Anjar

Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.09402	3.85813	0.36168	0.35514	0.79833	3.38275	4.14165	-18.32%
2	3.12349	3.94922	0.39474	0.41001	0.79833	3.43863	4.27654	-19.59%
3	3.48404	3.86970	0.39342	0.38438	0.79833	3.79811	4.17657	-9.06%
4	3.26069	3.92596	0.40251	0.33038	0.79833	3.58203	4.18971	-14.50%
5	3.09614	3.48193	0.39552	0.25165	0.79833	3.41190	3.68282	-7.36%
6	2.76043	3.22109	0.38755	0.19872	0.79833	3.06982	3.37973	-9.17%
7	2.96250	3.17000	0.39490	0.19696	0.79833	3.27776	3.32724	-1.49%
8	3.30876	3.34439	0.40499	0.22204	0.79833	3.63208	3.52164	3.14%
9	3.59391	3.45191	0.44412	0.29855	0.79833	3.94846	3.69025	7.00%
10	3.64864	3.53730	0.41458	0.30059	0.79833	3.97961	3.77727	5.36%
11	3.41473	3.86171	0.39291	0.35207	0.79833	3.72840	4.14278	-10.00%
12	3.29025	3.76684	0.38317	0.37748	0.79833	3.59614	4.06819	-11.60%
Average	3.25313	3.61985	0.39751	0.30650	0.79833	3.57047	3.86453	-7.13%

Appendix IV.d: Method 2 with cubic interpolation

Station 9: Lembang								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.49068	3.05030	0.39224	0.24383	1.50410	4.08065	3.41705	19.42%
2	3.55317	3.01503	0.39145	0.26085	1.50410	4.14195	3.40737	21.56%
3	3.56045	2.96402	0.37289	0.22412	1.50410	4.12131	3.30112	24.85%
4	3.32270	2.74129	0.33101	0.22341	1.50410	3.82057	3.07731	24.15%
5	3.08503	2.53605	0.31535	0.18551	1.50410	3.55934	2.81508	26.44%
6	2.89347	2.43641	0.31683	0.20344	1.50410	3.37002	2.74241	22.89%
7	3.08390	2.52758	0.33872	0.18347	1.50410	3.59336	2.80354	28.17%
8	3.41678	2.90970	0.43320	0.26350	1.50410	4.06835	3.30604	23.06%
9	3.72027	3.17504	0.51359	0.28764	1.50410	4.49276	3.60768	24.53%
10	3.73356	3.15366	0.41531	0.32456	1.50410	4.35822	3.64183	19.67%
11	3.55309	3.08696	0.36031	0.30187	1.50410	4.09503	3.54101	15.65%
12	3.52010	2.90463	0.43522	0.26205	1.50410	4.17471	3.29878	26.55%
Average	3.41110	2.87506	0.38468	0.24702	1.50410	3.98969	3.24660	23.08%

Station 10: Magelang								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.27219	3.52117	0.37040	0.38930	0.79833	3.56789	3.83196	-6.89%
2	3.33889	3.72436	0.39393	0.46600	0.79833	3.65337	4.09638	-10.81%
3	3.48601	3.78627	0.39976	0.44078	0.79833	3.80515	4.13816	-8.05%
4	3.43594	3.63280	0.40812	0.41750	0.79833	3.76176	3.96610	-5.15%
5	3.19106	3.41184	0.37142	0.41483	0.79833	3.48757	3.74301	-6.82%
6	3.02054	3.21146	0.40088	0.36351	0.79833	3.34058	3.50166	-4.60%
7	3.01274	3.42128	0.42947	0.38764	0.79833	3.35559	3.73075	-10.06%
8	3.22009	3.66365	0.41698	0.36699	0.79833	3.55298	3.95663	-10.20%
9	3.49613	4.20139	0.47978	0.47449	0.79833	3.87915	4.58019	-15.31%
10	3.52457	4.28084	0.46407	0.44271	0.79833	3.89505	4.63427	-15.95%
11	3.66798	4.06501	0.43912	0.44428	0.79833	4.01854	4.41969	-9.08%
12	3.35794	3.89229	0.39153	0.43804	0.79833	3.67052	4.24199	-13.47%
Average	3.33534	3.73436	0.41379	0.42051	0.79833	3.66568	4.07007	-9.70%

Station 11: Pangerango								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	2.87743	1.90581	0.28623	0.10838	2.00161	3.45036	2.12274	62.54%
2	2.84373	1.95985	0.35262	0.12101	2.00161	3.54954	2.20206	61.19%
3	2.74060	1.91211	0.30754	0.13382	2.00161	3.35617	2.17997	53.95%
4	2.59154	1.93285	0.30807	0.14763	2.00161	3.20817	2.22835	43.97%
5	2.44451	1.90638	0.34639	0.25085	2.00161	3.13786	2.40848	30.28%
6	2.47672	1.84720	0.37626	0.29923	2.00161	3.22984	2.44614	32.04%
7	2.41863	2.09233	0.46708	0.39058	2.00161	3.35354	2.87411	16.68%
8	3.03354	2.27431	0.36134	0.36812	2.00161	3.75680	3.01113	24.76%
9	2.91193	2.39046	0.45863	0.29031	2.00161	3.82993	2.97155	28.89%
10	3.69221	2.28787	0.47527	0.18469	2.00161	4.64351	2.65754	74.73%
11	3.37481	2.11511	0.36300	0.13282	2.00161	4.10140	2.38096	72.26%
12	2.21264	1.94685	0.32650	0.10809	2.00161	2.86617	2.16320	32.50%
Average	2.80152	2.04759	0.36908	0.21129	2.00161	3.54027	2.47052	44.48%

Station 12: Pasuruan								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.08141	3.88420	0.39403	0.50478	0.99502	3.47348	4.38647	-20.81%
2	3.17001	3.89871	0.37824	0.47138	1.20328	3.62513	4.46590	-18.83%
3	3.06792	4.07068	0.36216	0.45638	0.90246	3.39475	4.48255	-24.27%
4	2.96128	3.95293	0.32213	0.41939	1.20328	3.34890	4.45757	-24.87%
5	2.69388	3.53940	0.30306	0.41629	1.29584	3.08659	4.07884	-24.33%
6	2.55959	3.35490	0.31095	0.43596	1.39997	2.99491	3.96522	-24.47%
7	2.64212	3.38687	0.32960	0.54611	1.59666	3.16838	4.25883	-25.60%
8	2.91278	3.76741	0.38662	0.63903	1.80492	3.61059	4.92080	-26.63%
9	3.36515	4.17481	0.44788	0.65190	2.09417	4.30310	5.54000	-22.33%
10	3.59450	4.42967	0.48649	0.67310	1.89748	4.51761	5.70686	-20.84%
11	3.26458	4.38168	0.43597	0.64491	1.50410	3.92032	5.35168	-26.75%
12	3.18363	3.97893	0.41255	0.52686	1.20328	3.68005	4.61289	-20.22%
Average	3.04140	3.90168	0.38081	0.53217	1.42504	3.59365	4.68563	-23.33%

Appendix IV.d: Method 2 with cubic interpolation

Station 13: Rarahan								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	1.93122	2.87453	0.10358	0.27551	0.79833	2.01390	3.09448	-34.92%
2	1.97951	2.82733	0.11996	0.35012	0.79833	2.07528	3.10684	-33.20%
3	1.91795	2.69672	0.12808	0.29735	0.79833	2.02020	2.93410	-31.15%
4	1.92861	2.53752	0.14179	0.29873	0.79833	2.04181	2.77600	-26.45%
5	1.89793	2.39669	0.24126	0.33751	0.79833	2.09054	2.66613	-21.59%
6	1.83551	2.43159	0.29171	0.37287	0.79833	2.06839	2.72927	-24.21%
7	2.07836	2.36357	0.37667	0.46200	0.79833	2.37907	2.73240	-12.93%
8	2.26778	2.99984	0.35666	0.34911	0.79833	2.55251	3.27855	-22.15%
9	2.37911	2.84700	0.27964	0.44800	0.79833	2.60235	3.20465	-18.79%
10	2.28380	3.67102	0.17982	0.46972	0.79833	2.42735	4.04602	-40.01%
11	2.12007	3.35493	0.12949	0.35444	0.79833	2.22345	3.63788	-38.88%
12	1.95885	2.16321	0.10373	0.31690	0.79833	2.04166	2.41620	-15.50%
Average	2.04823	2.76366	0.20437	0.36102	0.79833	2.21138	3.05188	-26.65%

Station 14: Sawahan								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.57023	3.66307	0.52450	0.35650	0.79833	3.98895	3.94767	1.05%
2	3.62165	3.85427	0.50985	0.38202	0.79833	4.02867	4.15925	-3.14%
3	3.78503	4.08825	0.53881	0.35830	0.79833	4.21518	4.37429	-3.64%
4	3.73226	4.05929	0.52028	0.36067	0.79833	4.14761	4.34723	-4.59%
5	3.39163	3.61351	0.48433	0.35921	0.79833	3.77828	3.90028	-3.13%
6	3.39664	3.46188	0.49320	0.35780	0.79833	3.79038	3.74752	1.14%
7	3.48882	3.56132	0.46558	0.38745	0.79833	3.86050	3.87064	-0.26%
8	3.95952	4.03224	0.47753	0.47642	0.79833	4.34075	4.41258	-1.63%
9	4.42767	4.50988	0.49606	0.54071	0.79833	4.82368	4.94154	-2.39%
10	4.51922	4.75083	0.54484	0.59396	0.79833	4.95418	5.22501	-5.18%
11	4.32786	4.45930	0.54900	0.53364	0.79833	4.76615	4.88532	-2.44%
12	3.59734	4.05453	0.49864	0.46939	0.79833	3.99542	4.42925	-9.79%
Average	3.81816	4.00903	0.50855	0.43134	0.79833	4.22415	4.35338	-2.83%

Station 15: Semarang								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.74235	3.68185	0.35603	0.55806	0.99502	4.09660	4.23714	-3.32%
2	3.93905	3.65927	0.38262	0.53583	0.90246	4.28435	4.14283	3.42%
3	4.20909	3.90165	0.36129	0.57110	0.79833	4.49752	4.35758	3.21%
4	4.16657	3.82066	0.36493	0.54682	0.99502	4.52969	4.36476	3.78%
5	3.71769	3.45681	0.37089	0.52200	0.99502	4.08674	3.97621	2.78%
6	3.55034	3.49354	0.36720	0.52363	0.99502	3.91570	4.01456	-2.46%
7	3.66781	3.60246	0.38582	0.47571	0.90246	4.01600	4.03177	-0.39%
8	4.14501	4.13985	0.47480	0.48798	0.79833	4.52406	4.52942	-0.12%
9	4.62986	4.61170	0.53823	0.49733	0.79833	5.05954	5.00873	1.01%
10	4.85892	4.66559	0.59151	0.54590	0.90246	5.39273	5.15824	4.55%
11	4.57392	4.38737	0.53844	0.55667	0.99502	5.10967	4.94127	3.41%
12	4.15443	3.61556	0.47148	0.51433	0.99502	4.62356	4.12733	12.02%
Average	4.11292	3.91969	0.43360	0.52795	0.92271	4.51135	4.40749	2.32%

Station 20: Tosari								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.76160	2.66435	0.46764	0.35483	0.79833	4.13493	2.94762	40.28%
2	3.79992	2.67007	0.44947	0.33770	0.79833	4.15874	2.93967	41.47%
3	3.92644	2.51205	0.44398	0.31913	0.79833	4.28088	2.76682	54.72%
4	3.76236	2.38418	0.41937	0.28133	0.79833	4.09716	2.60877	57.05%
5	3.39178	2.17787	0.38951	0.29680	0.79833	3.70274	2.41482	53.33%
6	3.15020	2.04940	0.42044	0.32731	0.79833	3.48585	2.31070	50.86%
7	3.15946	2.12819	0.51762	0.35662	0.79833	3.57269	2.41289	48.07%
8	3.53215	2.35278	0.58734	0.37513	0.79833	4.00104	2.65226	50.85%
9	3.95832	2.70706	0.61762	0.43645	0.79833	4.45138	3.05550	45.68%
10	4.16989	2.87153	0.61826	0.44210	0.79833	4.66347	3.22448	44.63%
11	4.16790	2.42340	0.57610	0.35227	0.79833	4.62781	2.70463	71.11%
12	3.81373	2.57262	0.47490	0.35419	0.79833	4.19286	2.85538	46.84%
Average	3.71615	2.45946	0.49852	0.35282	0.79833	4.11413	2.74113	50.41%

Appendix IV.d: Method 2 with cubic interpolation

Station 22: Yogyakarta								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.11609	2.72862	0.35061	0.26350	5.65773	5.09976	4.21943	20.86%
2	3.27281	2.90131	0.41495	0.29648	5.16022	5.41403	4.43123	22.18%
3	3.40629	3.02116	0.41461	0.30509	4.41974	5.23874	4.36958	19.89%
4	3.26858	2.97874	0.42182	0.35891	4.74370	5.26957	4.68131	12.57%
5	3.06358	2.83719	0.42313	0.33588	3.52885	4.55672	4.02248	13.28%
6	2.80174	2.55880	0.40492	0.41457	3.84124	4.35714	4.15125	4.96%
7	3.03059	2.55146	0.42785	0.48208	4.17677	4.81761	4.56500	5.53%
8	3.40551	2.67167	0.38465	0.43394	4.41974	5.10555	4.58956	11.24%
9	3.80047	2.89705	0.42914	0.49135	4.89411	5.90073	5.30178	11.30%
10	3.92300	2.96120	0.41128	0.45479	5.57674	6.21660	5.49744	13.08%
11	3.57729	3.16888	0.37849	0.37862	5.11394	5.51284	5.10514	7.99%
12	3.34175	2.94982	0.38675	0.31588	4.89411	5.23456	4.49576	16.43%
Average	3.33398	2.85216	0.40402	0.37759	4.70224	5.22699	4.61916	13.28%

Station 24: Tegal								
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.50479	2.72279	0.43966	0.28924	6.53705	6.37886	4.61359	38.26%
2	3.45823	2.38747	0.42913	0.25605	6.97671	6.45212	4.17386	54.58%
3	3.58269	3.27721	0.43919	0.31864	5.38005	5.94557	4.99149	19.11%
4	3.45638	2.78924	0.42153	0.38819	5.28749	5.68523	4.84176	17.42%
5	3.13261	2.95453	0.38866	0.43621	4.99824	5.07521	5.13482	-1.16%
6	3.12908	2.53242	0.39640	0.48952	4.99824	5.11038	4.97917	2.64%
7	3.21772	2.76210	0.34395	0.53062	4.69742	4.83339	5.25463	-8.02%
8	3.68475	3.12887	0.38422	0.58788	4.54701	5.43181	5.80195	-6.38%
9	4.07916	3.33120	0.39363	0.58775	5.38005	6.19692	6.49331	-4.56%
10	4.04905	3.36634	0.44503	0.55106	4.94039	6.24766	6.08880	2.61%
11	3.89990	2.79679	0.45570	0.45832	5.14865	6.24616	5.15653	21.13%
12	3.37077	2.95053	0.40936	0.38977	5.59988	5.66315	5.13320	10.32%
Average	3.54709	2.91662	0.41221	0.44027	5.37427	5.77221	5.22193	12.16%

Appendix IV.e: Method 3 with linear interpolation

Station 1: Bandung												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8284	5.1659	1.0500	1.6448	0.1479	0.1717	0.0582	0.0614	1.0992	3.4290	3.8985	-12.04%
2	4.8011	5.2584	1.1143	1.6572	0.1482	0.1731	0.0582	0.0614	1.0992	3.4309	3.9707	-13.59%
3	4.7761	5.2344	1.0054	1.5767	0.1492	0.1735	0.0582	0.0614	1.0992	3.3903	3.9357	-13.86%
4	4.4619	4.9172	0.9941	1.3783	0.1480	0.1717	0.0582	0.0614	1.0992	3.1757	3.6614	-13.27%
5	4.1493	4.5708	0.8379	1.2750	0.1458	0.1690	0.0582	0.0614	1.0992	2.9174	3.3894	-13.93%
6	4.0065	4.3545	0.8692	1.2340	0.1419	0.1624	0.0582	0.0614	1.0992	2.8135	3.2043	-12.20%
7	4.2356	4.6803	0.7902	1.3029	0.1369	0.1582	0.0582	0.0614	1.0992	2.9070	3.4158	-14.90%
8	4.7821	5.1449	1.1032	1.7053	0.1412	0.1624	0.0582	0.0614	1.0992	3.3728	3.8535	-12.47%
9	5.1314	5.4824	1.2136	2.1011	0.1457	0.1717	0.0582	0.0614	1.0992	3.6577	4.2310	-13.55%
10	5.0753	5.5118	1.3719	1.6984	0.1499	0.1722	0.0582	0.0614	1.0992	3.6921	4.1471	-10.97%
11	4.9493	5.2931	1.2701	1.4571	0.1487	0.1690	0.0582	0.0614	1.0992	3.5743	3.9199	-8.82%
12	4.6309	5.1263	1.1098	1.8384	0.1475	0.1772	0.0582	0.0614	1.0992	3.3153	3.9483	-16.03%
Average	4.6523	5.0617	1.0608	1.5724	0.1459	0.1693	0.0582	0.0614	1.0992	3.3063	3.7980	-12.97%

Appendix IV.e: Method 3 with linear interpolation

Station 2: Bogor												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8766	4.6907	1.7209	1.7833	0.1750	0.1972	0.0603	0.0654	0.7983	3.7206	3.6315	2.45%
2	5.0336	4.9496	1.5777	1.5593	0.1750	0.1956	0.0603	0.0654	0.7983	3.8022	3.7654	0.98%
3	5.1330	5.2112	1.7103	1.6904	0.1771	0.1982	0.0603	0.0654	0.9025	3.9166	3.9928	-1.91%
4	5.0041	5.1765	1.7811	1.8195	0.1799	0.2008	0.0603	0.0654	0.9950	3.8648	4.0156	-3.76%
5	4.6187	4.7296	1.7951	1.8160	0.1800	0.2002	0.0603	0.0654	0.9025	3.5899	3.6899	-2.71%
6	4.4305	4.6345	1.8325	1.7759	0.1761	0.1956	0.0603	0.0654	0.9025	3.4523	3.5984	-4.06%
7	4.7689	4.8889	2.0692	1.9767	0.1741	0.1936	0.0603	0.0654	0.9950	3.7458	3.8245	-2.06%
8	5.3304	5.4534	2.0980	2.2211	0.1757	0.1962	0.0603	0.0654	0.9950	4.1437	4.2804	-3.19%
9	5.8221	6.0858	2.1574	2.5140	0.1788	0.2023	0.0603	0.0654	0.9950	4.5108	4.8124	-6.27%
10	5.7042	5.9812	1.9731	2.3041	0.1793	0.2039	0.0603	0.0654	1.2033	4.4124	4.7317	-6.75%
11	5.3600	5.4953	2.0421	2.1672	0.1813	0.2023	0.0603	0.0654	0.9950	4.1771	4.3224	-3.36%
12	4.9205	4.9633	1.8127	2.0146	0.1763	0.1987	0.0603	0.0654	0.9025	3.7874	3.8890	-2.61%
Average	5.0836	5.1883	1.8808	1.9702	0.1774	0.1987	0.0603	0.0654	0.9487	3.9270	4.0462	-2.77%

Station 3: Curug-Budiarto												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.9604	5.6402	1.6760	2.5139	0.2064	0.2263	0.0669	0.0670	0.7983	3.8203	4.5296	-15.66%
2	5.1177	5.8752	1.6195	2.2786	0.2061	0.2257	0.0669	0.0670	0.7983	3.9199	4.6578	-15.84%
3	5.5499	5.9779	1.7019	2.4197	0.2091	0.2274	0.0669	0.0670	0.7983	4.2546	4.7633	-10.68%
4	5.3898	5.8124	1.7525	2.5894	0.2114	0.2321	0.0669	0.0670	0.7983	4.1595	4.6885	-11.28%
5	4.9621	5.2352	1.9439	2.3414	0.2102	0.2303	0.0669	0.0670	0.7983	3.8845	4.2189	-7.93%
6	4.6696	4.9718	2.0054	2.3972	0.2053	0.2263	0.0669	0.0670	0.7983	3.6708	4.0239	-8.78%
7	4.9202	5.2811	1.9256	2.6065	0.2017	0.2234	0.0669	0.0670	0.7983	3.8196	4.2754	-10.66%
8	5.5262	6.0480	2.1312	2.6403	0.2043	0.2263	0.0669	0.0670	0.7983	4.2953	4.8476	-11.39%
9	6.0209	6.6896	2.3856	2.8225	0.2096	0.2303	0.0669	0.0670	0.7983	4.7156	5.3622	-12.06%
10	5.9236	6.5814	2.4179	2.7144	0.2166	0.2315	0.0669	0.0670	0.7983	4.6817	5.2697	-11.16%
11	5.5298	6.1849	2.2346	3.0427	0.2146	0.2362	0.0669	0.0670	0.7983	4.3586	5.0521	-13.73%
12	5.1972	5.6371	1.9111	2.6798	0.2073	0.2286	0.0669	0.0670	0.7983	4.0346	4.5638	-11.60%
Average	5.3140	5.8279	1.9754	2.5872	0.2086	0.2287	0.0669	0.0670	0.7983	4.1346	4.6877	-11.73%

Station 4: Djember												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.7565	5.4930	1.7780	1.8738	0.1746	0.2065	0.0617	0.0667	0.7983	3.6281	4.2366	-14.36%
2	5.0156	5.6608	1.6951	1.8768	0.1757	0.2065	0.0617	0.0667	0.7983	3.7959	4.3561	-12.86%
3	4.9478	5.6639	1.6609	1.8865	0.1747	0.2070	0.0617	0.0667	0.7983	3.7379	4.3624	-14.32%
4	4.8140	5.3560	1.5196	1.7492	0.1723	0.2034	0.0617	0.0667	0.7983	3.6068	4.1031	-12.10%
5	4.1942	4.8111	1.2981	1.2670	0.1658	0.1946	0.0617	0.0667	0.7983	3.1089	3.5926	-13.46%
6	4.0109	4.4246	1.2374	1.2318	0.1591	0.1872	0.0617	0.0667	0.7983	2.9432	3.2864	-10.44%
7	4.0965	4.4718	1.1877	1.2888	0.1534	0.1791	0.0617	0.0667	0.7983	2.9627	3.2950	-10.08%
8	4.4762	5.0756	1.2661	1.6508	0.1542	0.1848	0.0617	0.0667	0.7983	3.2348	3.8052	-14.99%
9	5.1746	5.9103	1.5218	1.9860	0.1607	0.1956	0.0617	0.0667	0.7983	3.7907	4.5003	-15.77%
10	5.5151	6.2654	1.6777	2.1434	0.1696	0.2028	0.0617	0.0667	0.7983	4.1042	4.8151	-14.76%
11	5.1361	6.0967	1.8588	2.0297	0.1743	0.2065	0.0617	0.0667	0.7983	3.9043	4.6930	-16.81%
12	4.9376	5.6349	2.0948	1.8691	0.1776	0.2049	0.0617	0.0667	0.7983	3.8278	4.3292	-11.58%
Average	4.7563	5.4053	1.5663	1.7377	0.1677	0.1982	0.0617	0.0667	0.7983	3.5538	4.1146	-13.46%

Station 5: Gunung Rosa												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.5866	4.2657	1.6712	1.3280	0.1827	0.1519	0.0635	0.0597	1.5041	3.5797	3.1689	12.96%
2	4.6401	4.4591	1.5297	1.3591	0.1825	0.1544	0.0635	0.0597	1.5041	3.5654	3.3134	7.61%
3	5.0979	4.8254	1.7330	1.5374	0.1883	0.1565	0.0635	0.0597	1.5041	3.9592	3.6204	9.36%
4	4.8365	4.7446	1.5635	1.4627	0.1868	0.1573	0.0635	0.0597	1.5041	3.7228	3.5460	4.99%
5	4.5800	4.3281	1.7245	1.2932	0.1867	0.1556	0.0635	0.0597	1.5041	3.6075	3.2123	12.30%
6	4.3417	4.1826	1.5252	1.0923	0.1795	0.1499	0.0635	0.0597	1.5041	3.3578	3.0196	11.20%
7	4.5737	4.4413	1.6614	1.1680	0.1770	0.1495	0.0635	0.0597	1.5041	3.5468	3.2074	10.58%
8	4.9153	4.8326	1.8530	1.4167	0.1766	0.1499	0.0635	0.0597	1.5041	3.8336	3.5468	8.09%
9	5.3419	5.0473	2.0787	1.5163	0.1837	0.1528	0.0635	0.0597	1.5041	4.2185	3.7336	12.99%
10	5.2170	5.3274	1.9833	1.6336	0.1881	0.1565	0.0635	0.0597	1.5041	4.1211	3.9738	3.71%
11	4.9559	5.0065	1.6772	1.5374	0.1861	0.1552	0.0635	0.0597	1.5041	3.8376	3.7287	2.92%
12	4.6685	4.2452	1.6835	1.3347	0.1844	0.1523	0.0635	0.0597	1.5041	3.6438	3.1603	15.30%
Average	4.8129	4.6422	1.7237	1.3900	0.1835	0.1535	0.0635	0.0597	1.5041	3.7495	3.4359	9.33%

Appendix IV.e: Method 3 with linear interpolation

Station 7: Karang Anjar												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.0821	5.4310	1.9464	1.5591	0.2097	0.2097	0.0660	0.0672	0.7983	3.9787	4.1416	-3.93%
2	5.1940	5.5307	2.1281	1.8231	0.2127	0.2135	0.0660	0.0672	0.7983	4.1026	4.2765	-4.07%
3	5.6245	5.4193	2.0881	1.7091	0.2153	0.2135	0.0660	0.0672	0.7983	4.4149	4.1766	5.71%
4	5.2688	5.5183	2.1359	1.4557	0.2159	0.2108	0.0660	0.0672	0.7983	4.1692	4.1897	-0.49%
5	5.1216	4.9419	2.1249	1.0830	0.2103	0.2039	0.0660	0.0672	0.7983	4.0414	3.6828	9.74%
6	4.6147	4.6505	2.0196	0.8220	0.2008	0.1926	0.0660	0.0672	0.7983	3.6282	3.3797	7.35%
7	5.0812	4.6441	2.0024	0.7889	0.1938	0.1838	0.0660	0.0672	0.7983	3.9257	3.3272	17.99%
8	5.5988	4.8875	2.0010	0.8942	0.1912	0.1853	0.0660	0.0672	0.7983	4.2743	3.5216	21.37%
9	6.0475	4.9877	2.2241	1.2327	0.2005	0.1921	0.0660	0.0672	0.7983	4.6754	3.6903	26.69%
10	5.9034	5.0552	2.1346	1.2728	0.2096	0.1992	0.0660	0.0672	0.7983	4.5988	3.7773	21.75%
11	5.4550	5.4645	1.9863	1.5262	0.2086	0.2060	0.0660	0.0672	0.7983	4.2476	4.1428	2.53%
12	5.3833	5.3182	2.0266	1.6452	0.2090	0.2076	0.0660	0.0672	0.7983	4.2055	4.0682	3.37%
Average	5.3646	5.1541	2.0682	1.3177	0.2065	0.2015	0.0660	0.0672	0.7983	4.1885	3.8645	9.00%

Station 9: Lembang												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.1818	4.8842	1.6458	0.9815	0.1768	0.1451	0.0621	0.0577	1.5041	3.9523	3.4170	15.67%
2	5.2572	4.8277	1.6455	1.0500	0.1776	0.1451	0.0621	0.0577	1.5041	4.0052	3.4074	17.54%
3	5.3219	4.7364	1.5931	0.9052	0.1788	0.1459	0.0621	0.0577	1.5041	4.0353	3.3011	22.24%
4	4.9835	4.3983	1.4430	0.8963	0.1773	0.1443	0.0621	0.0577	1.5041	3.7553	3.0773	22.03%
5	4.6569	4.0899	1.3898	0.7380	0.1745	0.1424	0.0621	0.0577	1.5041	3.5116	2.8151	24.74%
6	4.4044	3.9662	1.3742	0.7972	0.1682	0.1390	0.0621	0.0577	1.5041	3.3165	2.7424	20.93%
7	4.7279	4.1810	1.4230	0.7012	0.1642	0.1334	0.0621	0.0577	1.5041	3.5230	2.8035	25.66%
8	5.2167	4.7417	1.7964	1.0308	0.1678	0.1386	0.0621	0.0577	1.5041	3.9864	3.3060	20.58%
9	5.5743	5.1099	2.1797	1.1481	0.1773	0.1432	0.0621	0.0577	1.5041	4.3951	3.6077	21.83%
10	5.5904	5.0242	1.8199	1.3176	0.1783	0.1471	0.0621	0.0577	1.5041	4.2865	3.6418	17.70%
11	5.3270	4.9329	1.5707	1.2192	0.1751	0.1459	0.0621	0.0577	1.5041	4.0132	3.5410	13.34%
12	5.1688	4.6557	1.8635	1.0530	0.1822	0.1447	0.0621	0.0577	1.5041	4.0416	3.2988	22.52%
Average	5.1176	4.6290	1.6454	0.9865	0.1748	0.1429	0.0621	0.0577	1.5041	3.9018	3.2466	20.40%

Station 10: Magelang												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.3018	4.9836	1.8632	1.6867	0.2089	0.1972	0.0669	0.0644	0.7983	4.1059	3.8320	7.15%
2	5.3809	5.2164	1.9535	2.0714	0.2098	0.2044	0.0669	0.0644	0.7983	4.1820	4.0964	2.09%
3	5.4247	5.3032	1.9745	1.9593	0.2120	0.2044	0.0669	0.0644	0.7983	4.2261	4.1382	2.12%
4	5.3987	5.0995	2.0889	1.8456	0.2167	0.2028	0.0669	0.0644	0.7983	4.2462	3.9661	7.06%
5	4.8785	4.7893	1.8129	1.8338	0.2093	0.2028	0.0669	0.0644	0.7983	3.7976	3.7430	1.46%
6	4.6774	4.5696	1.9513	1.5551	0.2041	0.1936	0.0669	0.0644	0.7983	3.6615	3.5017	4.56%
7	4.7951	4.9413	2.0268	1.6022	0.1972	0.1843	0.0669	0.0644	0.7983	3.7333	3.7307	0.07%
8	5.1995	5.2661	1.9726	1.5334	0.1993	0.1872	0.0669	0.0644	0.7983	4.0143	3.9566	1.46%
9	5.6031	5.9418	2.3018	2.0596	0.2090	0.1977	0.0669	0.0644	0.7983	4.4000	4.5802	-3.93%
10	5.7162	6.0225	2.3979	1.9464	0.2190	0.2013	0.0669	0.0644	0.7983	4.5379	4.6343	-2.08%
11	5.8082	5.7146	2.2234	1.9569	0.2199	0.2018	0.0669	0.0644	0.7983	4.5773	4.4197	3.57%
12	5.3445	5.5005	1.9300	1.9049	0.2077	0.1982	0.0669	0.0644	0.7983	4.1433	4.2420	-2.33%
Average	5.2941	5.2790	2.0414	1.8296	0.2094	0.1980	0.0669	0.0644	0.7983	4.1355	4.0701	1.77%

Station 11: Pangerango												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.4579	3.7359	1.1064	0.3718	0.1421	0.0818	0.0582	0.0467	2.0016	3.1776	2.1227	49.70%
2	4.4066	3.8143	1.3052	0.4183	0.1431	0.0830	0.0582	0.0467	2.0016	3.2489	2.2021	47.54%
3	4.2865	3.7108	1.1849	0.4640	0.1452	0.0835	0.0582	0.0467	2.0016	3.1291	2.1800	43.54%
4	4.0473	3.7036	1.1853	0.5189	0.1464	0.0857	0.0582	0.0467	2.0016	2.9917	2.2283	34.26%
5	3.8058	3.6076	1.3256	0.8940	0.1468	0.0880	0.0582	0.0467	2.0016	2.9155	2.4085	21.05%
6	3.8560	3.5346	1.3914	1.0534	0.1431	0.0860	0.0582	0.0467	2.0016	2.9633	2.4461	21.14%
7	3.8291	4.0205	1.6713	1.3687	0.1400	0.0852	0.0582	0.0467	2.0016	3.0731	2.8741	6.92%
8	4.7280	4.3702	1.3674	1.2900	0.1397	0.0852	0.0582	0.0467	2.0016	3.4515	3.0111	14.63%
9	4.5730	4.6063	1.7389	1.0142	0.1447	0.0847	0.0582	0.0467	2.0016	3.5640	2.9716	19.94%
10	5.5684	4.4591	1.8076	0.6374	0.1482	0.0828	0.0582	0.0467	2.0016	4.2106	2.6575	58.44%
11	5.1228	4.1402	1.4047	0.4563	0.1470	0.0820	0.0582	0.0467	2.0016	3.7445	2.3810	57.27%
12	3.5397	3.8441	1.2696	0.3680	0.1458	0.0806	0.0582	0.0467	2.0016	2.7256	2.1632	26.00%
Average	4.3518	3.9623	1.3965	0.7379	0.1443	0.0840	0.0582	0.0467	2.0016	3.2663	2.4705	33.37%

Appendix IV.e: Method 3 with linear interpolation

Station 12: Pasuruan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8560	5.5105	1.6287	2.2890	0.1731	0.2151	0.0614	0.0673	0.9950	3.6824	4.3865	-16.05%
2	4.9814	5.6219	1.5411	2.1671	0.1723	0.2146	0.0614	0.0673	1.2033	3.7560	4.4659	-15.90%
3	4.7775	5.7563	1.5147	2.0367	0.1731	0.2124	0.0614	0.0673	0.9025	3.5953	4.4825	-19.79%
4	4.6020	5.7544	1.3762	1.8877	0.1707	0.2081	0.0614	0.0673	1.2033	3.4491	4.4576	-22.62%
5	4.3283	5.2443	1.2290	1.8447	0.1658	0.2013	0.0614	0.0673	1.2958	3.2067	4.0788	-21.38%
6	4.1230	5.0626	1.2388	1.9076	0.1593	0.1951	0.0614	0.0673	1.4000	3.0539	3.9652	-22.98%
7	4.3673	5.2315	1.2944	2.3896	0.1522	0.1907	0.0614	0.0673	1.5967	3.2055	4.2588	-24.73%
8	4.9036	5.8640	1.5662	2.8841	0.1554	0.1951	0.0614	0.0673	1.8049	3.6765	4.9208	-25.29%
9	5.5483	6.5770	1.8118	3.0557	0.1633	0.2002	0.0614	0.0673	2.0942	4.2433	5.5400	-23.41%
10	5.7265	6.7447	2.0722	3.2261	0.1724	0.2118	0.0614	0.0673	1.8975	4.4938	5.7069	-21.26%
11	5.1416	6.4222	1.8775	3.0677	0.1753	0.2184	0.0614	0.0673	1.5041	4.0085	5.3517	-25.10%
12	4.9308	5.7242	1.7517	2.4350	0.1747	0.2162	0.0614	0.0673	1.2033	3.7927	4.6129	-17.78%
Average	4.8572	5.7928	1.5752	2.4326	0.1673	0.2066	0.0614	0.0673	1.4251	3.6803	4.6856	-21.36%

Station 13: Rarahan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.8694	4.4375	0.4529	0.9945	0.0904	0.1334	0.0482	0.0570	0.7983	2.4206	3.0945	-21.78%
2	3.9412	4.3479	0.4996	1.2729	0.0914	0.1349	0.0482	0.0570	0.7983	2.4853	3.1068	-20.00%
3	3.8505	4.1312	0.5294	1.0888	0.0920	0.1363	0.0482	0.0570	0.7983	2.4442	2.9341	-16.70%
4	3.8108	3.8727	0.5782	1.1016	0.0940	0.1378	0.0482	0.0570	0.7983	2.4498	2.7760	-11.75%
5	3.6859	3.6543	0.9082	1.2469	0.0958	0.1382	0.0482	0.0570	0.7983	2.4705	2.6661	-7.34%
6	3.6019	3.7393	1.0568	1.3556	0.0936	0.1349	0.0482	0.0570	0.7983	2.4392	2.7293	-10.63%
7	4.0600	3.6664	1.3231	1.6530	0.0924	0.1316	0.0482	0.0570	0.7983	2.7720	2.7324	1.45%
8	4.4341	4.6626	1.2841	1.2447	0.0929	0.1308	0.0482	0.0570	0.7983	2.9918	3.2785	-8.74%
9	4.6888	4.3698	1.0560	1.6345	0.0930	0.1356	0.0482	0.0570	0.7983	3.0894	3.2047	-3.60%
10	4.5505	5.5817	0.7351	1.7447	0.0916	0.1393	0.0482	0.0570	0.7983	2.9117	4.0460	-28.04%
11	4.2496	5.1154	0.5621	1.3094	0.0908	0.1382	0.0482	0.0570	0.7983	2.6800	3.6379	-26.33%
12	3.9527	3.3045	0.4624	1.1666	0.0894	0.1375	0.0482	0.0570	0.7983	2.4628	2.4162	1.93%
Average	4.0580	4.2403	0.7873	1.3178	0.0923	0.1357	0.0482	0.0570	0.7983	2.6348	3.0519	-12.63%

Station 14: Sawahan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.3332	5.1467	2.2503	1.5724	0.2079	0.2108	0.0672	0.0671	0.7983	4.1911	3.9477	6.17%
2	5.3646	5.4114	2.1508	1.6880	0.2065	0.2113	0.0672	0.0671	0.7983	4.1895	4.1592	0.73%
3	5.4941	5.7315	2.2674	1.5889	0.2102	0.2124	0.0672	0.0671	0.7983	4.3176	4.3743	-1.30%
4	5.3988	5.6826	2.2726	1.6053	0.2153	0.2135	0.0672	0.0671	0.7983	4.2703	4.3472	-1.77%
5	4.9633	5.0959	2.0942	1.5700	0.2116	0.2081	0.0672	0.0671	0.7983	3.9137	3.9003	0.34%
6	4.9226	4.9340	2.1272	1.5247	0.2084	0.2008	0.0672	0.0671	0.7983	3.8793	3.7475	3.52%
7	5.1277	5.1112	1.9902	1.6245	0.2014	0.1962	0.0672	0.0671	0.7983	3.9724	3.8706	2.63%
8	5.7634	5.7381	2.1266	2.0376	0.2072	0.2018	0.0672	0.0671	0.7983	4.4703	4.4126	1.31%
9	6.3763	6.3042	2.2931	2.4154	0.2159	0.2146	0.0672	0.0671	0.7983	4.9762	4.9415	0.70%
10	6.4753	6.5613	2.5917	2.7369	0.2240	0.2240	0.0672	0.0671	0.7983	5.1361	5.2250	-1.70%
11	6.1747	6.1544	2.5324	2.4634	0.2216	0.2246	0.0672	0.0671	0.7983	4.8986	4.8853	0.27%
12	5.3373	5.6433	2.2265	2.1198	0.2109	0.2179	0.0672	0.0671	0.7983	4.2014	4.4293	-5.15%
Average	5.5609	5.6262	2.2436	1.9122	0.2117	0.2113	0.0672	0.0671	0.7983	4.3680	4.3534	0.48%

Station 15: Semarang												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.2014	5.3005	1.6172	2.4457	0.2106	0.2049	0.0672	0.0673	0.9950	4.0047	4.2371	-5.48%
2	5.4599	5.2423	1.6730	2.3189	0.2104	0.2034	0.0672	0.0673	0.9025	4.1926	4.1428	1.20%
3	5.7082	5.5064	1.6147	2.4916	0.2122	0.2081	0.0672	0.0673	0.7983	4.3607	4.3576	0.07%
4	5.6160	5.4208	1.6120	2.4792	0.2132	0.2151	0.0672	0.0673	0.9950	4.3054	4.3648	-1.36%
5	5.0986	4.9156	1.6117	2.3540	0.2085	0.2135	0.0672	0.0673	0.9950	3.9235	3.9762	-1.33%
6	4.8996	4.9754	1.5855	2.3529	0.2015	0.2124	0.0672	0.0673	0.9950	3.7513	4.0146	-6.56%
7	5.1218	5.1410	1.6134	2.0773	0.1964	0.2060	0.0672	0.0673	0.9025	3.8836	4.0318	-3.68%
8	5.7589	5.8039	1.9851	2.1640	0.2015	0.2129	0.0672	0.0673	0.7983	4.4152	4.5294	-2.52%
9	6.3437	6.4006	2.3250	2.2624	0.2126	0.2206	0.0672	0.0673	0.7983	4.9439	5.0087	-1.29%
10	6.5333	6.4839	2.6180	2.5439	0.2216	0.2257	0.0672	0.0673	0.9025	5.1921	5.1582	0.66%
11	6.1189	6.1788	2.3958	2.5696	0.2223	0.2206	0.0672	0.0673	0.9950	4.8697	4.9413	-1.45%
12	5.6160	5.1768	2.0754	2.2824	0.2167	0.2086	0.0672	0.0673	0.9950	4.4214	4.1273	7.13%
Average	5.6230	5.5455	1.8939	2.3618	0.2106	0.2127	0.0672	0.0673	0.9227	4.3553	4.4075	-1.22%

Appendix IV.e: Method 3 with linear interpolation

Station 20: Tosari												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.4650	4.1342	2.0160	1.2689	0.2109	0.1262	0.0669	0.0548	0.7983	4.2578	2.9476	44.45%
2	5.6078	4.1391	1.9864	1.2098	0.2108	0.1266	0.0669	0.0548	0.7983	4.3539	2.9397	48.11%
3	5.6627	3.8941	1.9317	1.1433	0.2103	0.1266	0.0669	0.0548	0.7983	4.3810	2.7668	58.34%
4	5.5239	3.7252	1.8624	0.9936	0.2078	0.1238	0.0669	0.0548	0.7983	4.2589	2.6088	63.25%
5	5.0000	3.4304	1.5911	1.0335	0.1995	0.1211	0.0669	0.0548	0.7983	3.8039	2.4148	57.52%
6	4.7089	3.2681	1.6639	1.1159	0.1930	0.1171	0.0669	0.0548	0.7983	3.5876	2.3107	55.26%
7	4.8225	3.4519	1.9491	1.1824	0.1867	0.1120	0.0669	0.0548	0.7983	3.6958	2.4129	53.17%
8	5.3966	3.8079	2.2852	1.2481	0.1909	0.1126	0.0669	0.0548	0.7983	4.1753	2.6523	57.42%
9	6.1202	4.3035	2.5707	1.4959	0.1995	0.1181	0.0669	0.0548	0.7983	4.7730	3.0555	56.21%
10	6.3663	4.4957	2.7109	1.5559	0.2097	0.1231	0.0669	0.0548	0.7983	5.0200	3.2245	55.68%
11	6.1845	3.7752	2.5203	1.2508	0.2144	0.1249	0.0669	0.0548	0.7983	4.8771	2.7046	80.33%
12	5.6509	3.9958	2.1077	1.2643	0.2101	0.1259	0.0669	0.0548	0.7983	4.4035	2.8554	54.22%
Average	5.5424	3.8684	2.0996	1.2302	0.2036	0.1215	0.0669	0.0548	0.7983	4.2990	2.7411	57.00%

Station 22: Yogyakarta												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.7844	5.2393	1.7259	1.6076	0.1915	0.2113	0.0634	0.0665	5.6577	4.0739	4.2194	-3.45%
2	4.9828	5.4036	1.9382	1.7635	0.1948	0.2124	0.0634	0.0665	5.1602	4.3437	4.4312	-1.97%
3	5.1774	5.3706	1.9205	1.7454	0.1962	0.2140	0.0634	0.0665	4.4197	4.3788	4.3696	0.21%
4	4.9582	5.3246	1.9690	2.1286	0.1967	0.2206	0.0634	0.0665	4.7437	4.3256	4.6813	-7.60%
5	4.7037	4.8216	1.9654	1.7953	0.1935	0.2092	0.0634	0.0665	3.5289	4.0540	4.0225	0.78%
6	4.2980	4.4835	1.8928	2.2269	0.1842	0.2039	0.0634	0.0665	3.8412	3.7912	4.1512	-8.67%
7	4.7346	4.6288	1.9169	2.5997	0.1776	0.1977	0.0634	0.0665	4.1768	4.0736	4.5650	-10.76%
8	5.3464	4.9327	1.8096	2.3693	0.1759	0.1967	0.0634	0.0665	4.4197	4.3265	4.5896	-5.73%
9	5.8094	5.3509	1.9643	2.8543	0.1833	0.2092	0.0634	0.0665	4.8941	4.7540	5.3018	-10.33%
10	5.8346	5.5071	1.9413	2.8491	0.1912	0.2240	0.0634	0.0665	5.5767	4.8076	5.4974	-12.55%
11	5.2446	5.7194	1.7407	2.3253	0.1904	0.2263	0.0634	0.0665	5.1139	4.2933	5.1051	-15.90%
12	4.9987	5.4740	1.8226	1.8249	0.1904	0.2070	0.0634	0.0665	4.8941	4.2229	4.4958	-6.07%
Average	5.0727	5.1880	1.8839	2.1742	0.1888	0.2110	0.0634	0.0665	4.7022	4.2871	4.6192	-6.84%

Station 24: Tegal												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.1563	5.4455	1.8834	1.8642	0.1861	0.2168	0.0643	0.0673	6.5370	4.4527	4.6136	-3.49%
2	5.1308	4.9566	1.8307	1.6658	0.1850	0.2108	0.0643	0.0673	6.9767	4.4062	4.1739	5.57%
3	5.2899	6.1037	1.8886	1.9467	0.1885	0.2206	0.0643	0.0673	5.3800	4.4558	4.9915	-10.73%
4	5.1115	5.1923	1.8809	2.3466	0.1923	0.2184	0.0643	0.0673	5.2875	4.3593	4.8418	-9.97%
5	4.6672	5.5127	1.7935	2.5375	0.1907	0.2097	0.0643	0.0673	4.9982	4.0259	5.1348	-21.60%
6	4.6279	4.7590	1.8188	2.8244	0.1885	0.2065	0.0643	0.0673	4.9982	4.0238	4.9792	-19.19%
7	4.8214	5.1106	1.6033	2.9989	0.1826	0.2054	0.0643	0.0673	4.6974	3.9038	5.2546	-25.71%
8	5.4468	5.8115	1.7731	3.2424	0.1886	0.1997	0.0643	0.0673	4.5470	4.3874	5.8019	-24.38%
9	5.9628	6.2557	1.8980	3.5570	0.1951	0.2168	0.0643	0.0673	5.3800	4.8275	6.4933	-25.65%
10	5.9834	6.0749	2.1172	3.3121	0.1997	0.2240	0.0643	0.0673	4.9404	5.0200	6.0888	-17.55%
11	5.7418	5.1778	2.0868	2.7414	0.1962	0.2173	0.0643	0.0673	5.1486	4.8719	5.1565	-5.52%
12	5.0348	5.5296	1.8392	2.4268	0.1885	0.2234	0.0643	0.0673	5.5999	4.2944	5.1332	-16.34%
Average	5.2479	5.4942	1.8678	2.6220	0.1902	0.2141	0.0643	0.0673	5.3742	4.4191	5.2219	-14.55%

Appendix IV.f: Method 4 with linear interpolation

Station 1: Bandung												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.8284	5.1659	1.0500	1.6448	0.1479	0.1717	0.0616	0.0614	1.0992	3.3765	3.8985	-13.39%
2	4.8011	5.2584	1.1143	1.6572	0.1482	0.1731	0.0616	0.0614	1.0992	3.3795	3.9707	-14.89%
3	4.7761	5.2344	1.0054	1.5767	0.1492	0.1735	0.0616	0.0614	1.0992	3.3381	3.9357	-15.18%
4	4.4619	4.9172	0.9941	1.3783	0.1480	0.1717	0.0616	0.0614	1.0992	3.1275	3.6614	-14.58%
5	4.1493	4.5708	0.8379	1.2750	0.1458	0.1690	0.0616	0.0614	1.0992	2.8714	3.3894	-15.28%
6	4.0065	4.3545	0.8692	1.2340	0.1419	0.1624	0.0616	0.0614	1.0992	2.7694	3.2043	-13.57%
7	4.2356	4.6803	0.7902	1.3029	0.1369	0.1582	0.0616	0.0614	1.0992	2.8585	3.4158	-16.32%
8	4.7821	5.1449	1.1032	1.7053	0.1412	0.1624	0.0616	0.0614	1.0992	3.3208	3.8535	-13.82%
9	5.1314	5.4824	1.2136	2.1011	0.1457	0.1717	0.0616	0.0614	1.0992	3.6027	4.2310	-14.85%
10	5.0753	5.5118	1.3719	1.6984	0.1499	0.1722	0.0616	0.0614	1.0992	3.6399	4.1471	-12.23%
11	4.9493	5.2931	1.2701	1.4571	0.1487	0.1690	0.0616	0.0614	1.0992	3.5226	3.9199	-10.14%
12	4.6309	5.1263	1.1098	1.8384	0.1475	0.1772	0.0616	0.0614	1.0992	3.2660	3.9483	-17.28%
Average	4.6523	5.0617	1.0608	1.5724	0.1459	0.1693	0.0616	0.0614	1.0992	3.2561	3.7980	-14.29%

Appendix IV.f: Method 4 with linear interpolation

Station 2: Bogor												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.8766	4.6907	1.7209	1.7833	0.1750	0.1972	0.0662	0.0654	0.7983	3.6433	3.6315	0.32%
2	5.0336	4.9496	1.5777	1.5593	0.1750	0.1956	0.0662	0.0654	0.7983	3.7199	3.7654	-1.21%
3	5.1330	5.2112	1.7103	1.6904	0.1771	0.1982	0.0662	0.0654	0.9025	3.8357	3.9928	-3.93%
4	5.0041	5.1765	1.7811	1.8195	0.1799	0.2008	0.0662	0.0654	0.9950	3.7893	4.0156	-5.64%
5	4.6187	4.7296	1.7951	1.8160	0.1800	0.2002	0.0662	0.0654	0.9025	3.5212	3.6899	-4.57%
6	4.4305	4.6345	1.8325	1.7759	0.1761	0.1956	0.0662	0.0654	0.9025	3.3874	3.5984	-5.86%
7	4.7689	4.8889	2.0692	1.9767	0.1741	0.1936	0.0662	0.0654	0.9950	3.6787	3.8245	-3.81%
8	5.3304	5.4534	2.0980	2.2211	0.1757	0.1962	0.0662	0.0654	0.9950	4.0657	4.2804	-5.02%
9	5.8221	6.0858	2.1574	2.5140	0.1788	0.2023	0.0662	0.0654	0.9950	4.4240	4.8124	-8.07%
10	5.7042	5.9812	1.9731	2.3041	0.1793	0.2039	0.0662	0.0654	1.2033	4.3283	4.7317	-8.53%
11	5.3600	5.4953	2.0421	2.1672	0.1813	0.2023	0.0662	0.0654	0.9950	4.0984	4.3224	-5.18%
12	4.9205	4.9633	1.8127	2.0146	0.1763	0.1987	0.0662	0.0654	0.9025	3.7122	3.8890	-4.55%
Average	5.0836	5.1883	1.8808	1.9702	0.1774	0.1987	0.0662	0.0654	0.9487	3.8503	4.0462	-4.67%

Station 3: Curug-Budiarto												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.9604	5.6402	1.6760	2.5139	0.2064	0.2263	0.0671	0.0670	0.7983	3.8173	4.5296	-15.73%
2	5.1177	5.8752	1.6195	2.2786	0.2061	0.2257	0.0671	0.0670	0.7983	3.9167	4.6578	-15.91%
3	5.5499	5.9779	1.7019	2.4197	0.2091	0.2274	0.0671	0.0670	0.7983	4.2511	4.7633	-10.75%
4	5.3898	5.8124	1.7525	2.5894	0.2114	0.2321	0.0671	0.0670	0.7983	4.1561	4.6885	-11.36%
5	4.9621	5.2352	1.9439	2.3414	0.2102	0.2303	0.0671	0.0670	0.7983	3.8816	4.2189	-7.99%
6	4.6696	4.9718	2.0054	2.3972	0.2053	0.2263	0.0671	0.0670	0.7983	3.6681	4.0239	-8.84%
7	4.9202	5.2811	1.9256	2.6065	0.2017	0.2234	0.0671	0.0670	0.7983	3.8166	4.2754	-10.73%
8	5.5262	6.0480	2.1312	2.6403	0.2043	0.2263	0.0671	0.0670	0.7983	4.2920	4.8476	-11.46%
9	6.0209	6.6896	2.3856	2.8225	0.2096	0.2303	0.0671	0.0670	0.7983	4.7121	5.3622	-12.12%
10	5.9236	6.5814	2.4179	2.7144	0.2166	0.2315	0.0671	0.0670	0.7983	4.6783	5.2697	-11.22%
11	5.5298	6.1849	2.2346	3.0427	0.2146	0.2362	0.0671	0.0670	0.7983	4.3554	5.0521	-13.79%
12	5.1972	5.6371	1.9111	2.6798	0.2073	0.2286	0.0671	0.0670	0.7983	4.0315	4.5638	-11.66%
Average	5.3140	5.8279	1.9754	2.5872	0.2086	0.2287	0.0671	0.0670	0.7983	4.1314	4.6877	-11.80%

Station 4: Djember												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.7565	5.4930	1.7780	1.8738	0.1746	0.2065	0.0664	0.0667	0.7983	3.5701	4.2366	-15.73%
2	5.0156	5.6608	1.6951	1.8768	0.1757	0.2065	0.0664	0.0667	0.7983	3.7331	4.3561	-14.30%
3	4.9478	5.6639	1.6609	1.8865	0.1747	0.2070	0.0664	0.0667	0.7983	3.6757	4.3624	-15.74%
4	4.8140	5.3560	1.5196	1.7492	0.1723	0.2034	0.0664	0.0667	0.7983	3.5450	4.1031	-13.60%
5	4.1942	4.8111	1.2981	1.2670	0.1658	0.1946	0.0664	0.0667	0.7983	3.0541	3.5926	-14.99%
6	4.0109	4.4246	1.2374	1.2318	0.1591	0.1872	0.0664	0.0667	0.7983	2.8900	3.2864	-12.06%
7	4.0965	4.4718	1.1877	1.2888	0.1534	0.1791	0.0664	0.0667	0.7983	2.9069	3.2950	-11.78%
8	4.4762	5.0756	1.2661	1.6508	0.1542	0.1848	0.0664	0.0667	0.7983	3.1737	3.8052	-16.60%
9	5.1746	5.9103	1.5218	1.9860	0.1607	0.1956	0.0664	0.0667	0.7983	3.7215	4.5003	-17.31%
10	5.5151	6.2654	1.6777	2.1434	0.1696	0.2028	0.0664	0.0667	0.7983	4.0324	4.8151	-16.26%
11	5.1361	6.0967	1.8588	2.0297	0.1743	0.2065	0.0664	0.0667	0.7983	3.8410	4.6930	-18.15%
12	4.9376	5.6349	2.0948	1.8691	0.1776	0.2049	0.0664	0.0667	0.7983	3.7705	4.3292	-12.91%
Average	4.7563	5.4053	1.5663	1.7377	0.1677	0.1982	0.0664	0.0667	0.7983	3.4928	4.1146	-14.95%

Station 5: Gunung Rosa												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.5866	4.2657	1.6712	1.3280	0.1827	0.1519	0.0592	0.0597	1.5041	3.6256	3.1689	14.41%
2	4.6401	4.4591	1.5297	1.3591	0.1825	0.1544	0.0592	0.0597	1.5041	3.6144	3.3134	9.08%
3	5.0979	4.8254	1.7330	1.5374	0.1883	0.1565	0.0592	0.0597	1.5041	4.0117	3.6204	10.81%
4	4.8365	4.7446	1.5635	1.4627	0.1868	0.1573	0.0592	0.0597	1.5041	3.7740	3.5460	6.43%
5	4.5800	4.3281	1.7245	1.2932	0.1867	0.1556	0.0592	0.0597	1.5041	3.6522	3.2123	13.69%
6	4.3417	4.1826	1.5252	1.0923	0.1795	0.1499	0.0592	0.0597	1.5041	3.4025	3.0196	12.68%
7	4.5737	4.4413	1.6614	1.1680	0.1770	0.1495	0.0592	0.0597	1.5041	3.5932	3.2074	12.03%
8	4.9153	4.8326	1.8530	1.4167	0.1766	0.1499	0.0592	0.0597	1.5041	3.8824	3.5468	9.46%
9	5.3419	5.0473	2.0787	1.5163	0.1837	0.1528	0.0592	0.0597	1.5041	4.2699	3.7336	14.36%
10	5.2170	5.3274	1.9833	1.6336	0.1881	0.1565	0.0592	0.0597	1.5041	4.1716	3.9738	4.98%
11	4.9559	5.0065	1.6772	1.5374	0.1861	0.1552	0.0592	0.0597	1.5041	3.8890	3.7287	4.30%
12	4.6685	4.2452	1.6835	1.3347	0.1844	0.1523	0.0592	0.0597	1.5041	3.6907	3.1603	16.78%
Average	4.8129	4.6422	1.7237	1.3900	0.1835	0.1535	0.0592	0.0597	1.5041	3.7981	3.4359	10.75%

Appendix IV.f: Method 4 with linear interpolation

Station 7: Karang Anjar												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.0821	5.4310	1.9464	1.5591	0.2097	0.2097	0.0661	0.0672	0.7983	3.9772	4.1416	-3.97%
2	5.1940	5.5307	2.1281	1.8231	0.2127	0.2135	0.0661	0.0672	0.7983	4.1011	4.2765	-4.10%
3	5.6245	5.4193	2.0881	1.7091	0.2153	0.2135	0.0661	0.0672	0.7983	4.4131	4.1766	5.66%
4	5.2688	5.5183	2.1359	1.4557	0.2159	0.2108	0.0661	0.0672	0.7983	4.1677	4.1897	-0.53%
5	5.1216	4.9419	2.1249	1.0830	0.2103	0.2039	0.0661	0.0672	0.7983	4.0399	3.6828	9.70%
6	4.6147	4.6505	2.0196	0.8220	0.2008	0.1926	0.0661	0.0672	0.7983	3.6268	3.3797	7.31%
7	5.0812	4.6441	2.0024	0.7889	0.1938	0.1838	0.0661	0.0672	0.7983	3.9241	3.3272	17.94%
8	5.5988	4.8875	2.0010	0.8942	0.1912	0.1853	0.0661	0.0672	0.7983	4.2725	3.5216	21.32%
9	6.0475	4.9877	2.2241	1.2327	0.2005	0.1921	0.0661	0.0672	0.7983	4.6735	3.6903	26.64%
10	5.9034	5.0552	2.1346	1.2728	0.2096	0.1992	0.0661	0.0672	0.7983	4.5970	3.7773	21.70%
11	5.4550	5.4645	1.9863	1.5262	0.2086	0.2060	0.0661	0.0672	0.7983	4.2460	4.1428	2.49%
12	5.3833	5.3182	2.0266	1.6452	0.2090	0.2076	0.0661	0.0672	0.7983	4.2039	4.0682	3.34%
Average	5.3646	5.1541	2.0682	1.3177	0.2065	0.2015	0.0661	0.0672	0.7983	4.1869	3.8645	8.96%

Station 9: Lembang												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.1818	4.8842	1.6458	0.9815	0.1768	0.1451	0.0596	0.0577	1.5041	3.9860	3.4170	16.65%
2	5.2572	4.8277	1.6455	1.0500	0.1776	0.1451	0.0596	0.0577	1.5041	4.0395	3.4074	18.55%
3	5.3219	4.7364	1.5931	0.9052	0.1788	0.1459	0.0596	0.0577	1.5041	4.0707	3.3011	23.31%
4	4.9835	4.3983	1.4430	0.8963	0.1773	0.1443	0.0596	0.0577	1.5041	3.7890	3.0773	23.13%
5	4.6569	4.0899	1.3898	0.7380	0.1745	0.1424	0.0596	0.0577	1.5041	3.5428	2.8151	25.85%
6	4.4044	3.9662	1.3742	0.7972	0.1682	0.1390	0.0596	0.0577	1.5041	3.3458	2.7424	22.00%
7	4.7279	4.1810	1.4230	0.7012	0.1642	0.1334	0.0596	0.0577	1.5041	3.5551	2.8035	26.81%
8	5.2167	4.7417	1.7964	1.0308	0.1678	0.1386	0.0596	0.0577	1.5041	4.0194	3.3060	21.58%
9	5.5743	5.1099	2.1797	1.1481	0.1773	0.1432	0.0596	0.0577	1.5041	4.4274	3.6077	22.72%
10	5.5904	5.0242	1.8199	1.3176	0.1783	0.1471	0.0596	0.0577	1.5041	4.3223	3.6418	18.69%
11	5.3270	4.9329	1.5707	1.2192	0.1751	0.1459	0.0596	0.0577	1.5041	4.0490	3.5410	14.35%
12	5.1688	4.6557	1.8635	1.0530	0.1822	0.1447	0.0596	0.0577	1.5041	4.0728	3.2988	23.46%
Average	5.1176	4.6290	1.6454	0.9865	0.1748	0.1429	0.0596	0.0577	1.5041	3.9350	3.2466	21.43%

Station 10: Magelang												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.3018	4.9836	1.8632	1.6867	0.2089	0.1972	0.0647	0.0644	0.7983	4.1339	3.8320	7.88%
2	5.3809	5.2164	1.9535	2.0714	0.2098	0.2044	0.0647	0.0644	0.7983	4.2100	4.0964	2.77%
3	5.4247	5.3032	1.9745	1.9593	0.2120	0.2044	0.0647	0.0644	0.7983	4.2542	4.1382	2.80%
4	5.3987	5.0995	2.0889	1.8456	0.2167	0.2028	0.0647	0.0644	0.7983	4.2734	3.9661	7.75%
5	4.8785	4.7893	1.8129	1.8338	0.2093	0.2028	0.0647	0.0644	0.7983	3.8229	3.7430	2.13%
6	4.6774	4.5696	1.9513	1.5551	0.2041	0.1936	0.0647	0.0644	0.7983	3.6851	3.5017	5.24%
7	4.7951	4.9413	2.0268	1.6022	0.1972	0.1843	0.0647	0.0644	0.7983	3.7577	3.7307	0.72%
8	5.1995	5.2661	1.9726	1.5334	0.1993	0.1872	0.0647	0.0644	0.7983	4.0416	3.9566	2.15%
9	5.6031	5.9418	2.3018	2.0596	0.2090	0.1977	0.0647	0.0644	0.7983	4.4281	4.5802	-3.32%
10	5.7162	6.0225	2.3979	1.9464	0.2190	0.2013	0.0647	0.0644	0.7983	4.5658	4.6343	-1.48%
11	5.8082	5.7146	2.2234	1.9569	0.2199	0.2018	0.0647	0.0644	0.7983	4.6065	4.4197	4.23%
12	5.3445	5.5005	1.9300	1.9049	0.2077	0.1982	0.0647	0.0644	0.7983	4.1713	4.2420	-1.67%
Average	5.2941	5.2790	2.0414	1.8296	0.2094	0.1980	0.0647	0.0644	0.7983	4.1625	4.0701	2.43%

Station 11: Pangerango												
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**gamma (IP)**	**gamma (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.4579	3.7359	1.1064	0.3718	0.1421	0.0818	0.0492	0.0467	2.0016	3.3021	2.1227	55.56%
2	4.4066	3.8143	1.3052	0.4183	0.1431	0.0830	0.0492	0.0467	2.0016	3.3617	2.2021	52.66%
3	4.2865	3.7108	1.1849	0.4640	0.1452	0.0835	0.0492	0.0467	2.0016	3.2425	2.1800	48.74%
4	4.0473	3.7036	1.1853	0.5189	0.1464	0.0857	0.0492	0.0467	2.0016	3.0954	2.2283	38.91%
5	3.8058	3.6076	1.3256	0.8940	0.1468	0.0880	0.0492	0.0467	2.0016	3.0031	2.4085	24.69%
6	3.8560	3.5346	1.3914	1.0534	0.1431	0.0860	0.0492	0.0467	2.0016	3.0503	2.4461	24.70%
7	3.8291	4.0205	1.6713	1.3687	0.1400	0.0852	0.0492	0.0467	2.0016	3.1462	2.8741	9.47%
8	4.7280	4.3702	1.3674	1.2900	0.1397	0.0852	0.0492	0.0467	2.0016	3.5749	3.0111	18.72%
9	4.5730	4.6063	1.7389	1.0142	0.1447	0.0847	0.0492	0.0467	2.0016	3.6628	2.9716	23.26%
10	5.5684	4.4591	1.8076	0.6374	0.1482	0.0828	0.0492	0.0467	2.0016	4.3447	2.6575	63.49%
11	5.1228	4.1402	1.4047	0.4563	0.1470	0.0820	0.0492	0.0467	2.0016	3.8802	2.3810	62.97%
12	3.5397	3.8441	1.2696	0.3680	0.1458	0.0806	0.0492	0.0467	2.0016	2.8055	2.1632	29.69%
Average	4.3518	3.9623	1.3965	0.7379	0.1443	0.0840	0.0492	0.0467	2.0016	3.3725	2.4705	37.74%

Appendix IV.f: Method 4 with linear interpolation

Station 12: Pasuruan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8560	5.5105	1.6287	2.2890	0.1731	0.2151	0.0673	0.0673	0.9950	3.6083	4.3865	-17.74%
2	4.9814	5.6219	1.5411	2.1671	0.1723	0.2146	0.0673	0.0673	1.2033	3.6800	4.4659	-17.60%
3	4.7775	5.7563	1.5147	2.0367	0.1731	0.2124	0.0673	0.0673	0.9025	3.5200	4.4825	-21.47%
4	4.6020	5.7544	1.3762	1.8877	0.1707	0.2081	0.0673	0.0673	1.2033	3.3780	4.4576	-24.22%
5	4.3283	5.2443	1.2290	1.8447	0.1658	0.2013	0.0673	0.0673	1.2958	3.1387	4.0788	-23.05%
6	4.1230	5.0626	1.2388	1.9076	0.1593	0.1951	0.0673	0.0673	1.4000	2.9907	3.9652	-24.58%
7	4.3673	5.2315	1.2944	2.3896	0.1522	0.1907	0.0673	0.0673	1.5967	3.1392	4.2588	-26.29%
8	4.9036	5.8640	1.5662	2.8841	0.1554	0.1951	0.0673	0.0673	1.8049	3.6071	4.9208	-26.70%
9	5.5483	6.5770	1.8118	3.0557	0.1633	0.2002	0.0673	0.0673	2.0942	4.1699	5.5400	-24.73%
10	5.7265	6.7447	2.0722	3.2261	0.1724	0.2118	0.0673	0.0673	1.8975	4.4217	5.7069	-22.52%
11	5.1416	6.4222	1.8775	3.0677	0.1753	0.2184	0.0673	0.0673	1.5041	3.9396	5.3517	-26.39%
12	4.9308	5.7242	1.7517	2.4350	0.1747	0.2162	0.0673	0.0673	1.2033	3.7219	4.6129	-19.32%
Average	4.8572	5.7928	1.5752	2.4326	0.1673	0.2066	0.0673	0.0673	1.4251	3.6096	4.6856	-22.88%

Station 13: Rarahan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.8694	4.4375	0.4529	0.9945	0.0904	0.1334	0.0559	0.0570	0.7983	2.2908	3.0945	-25.97%
2	3.9412	4.3479	0.4996	1.2729	0.0914	0.1349	0.0559	0.0570	0.7983	2.3543	3.1068	-24.22%
3	3.8505	4.1312	0.5294	1.0888	0.0920	0.1363	0.0559	0.0570	0.7983	2.3172	2.9341	-21.03%
4	3.8108	3.8727	0.5782	1.1016	0.0940	0.1378	0.0559	0.0570	0.7983	2.3258	2.7760	-16.22%
5	3.6859	3.6543	0.9082	1.2469	0.0958	0.1382	0.0559	0.0570	0.7983	2.3588	2.6661	-11.53%
6	3.6019	3.7393	1.0568	1.3556	0.0936	0.1349	0.0559	0.0570	0.7983	2.3335	2.7293	-14.50%
7	4.0600	3.6664	1.3231	1.6530	0.0924	0.1316	0.0559	0.0570	0.7983	2.6555	2.7324	-2.81%
8	4.4341	4.6626	1.2841	1.2447	0.0929	0.1308	0.0559	0.0570	0.7983	2.8611	3.2785	-12.73%
9	4.6888	4.3698	1.0560	1.6345	0.0930	0.1356	0.0559	0.0570	0.7983	2.9444	3.2047	-8.12%
10	4.5505	5.5817	0.7351	1.7447	0.0916	0.1393	0.0559	0.0570	0.7983	2.7641	4.0460	-31.68%
11	4.2496	5.1154	0.5621	1.3094	0.0908	0.1382	0.0559	0.0570	0.7983	2.5390	3.6379	-30.21%
12	3.9527	3.3045	0.4624	1.1666	0.0894	0.1375	0.0559	0.0570	0.7983	2.3300	2.4162	-3.57%
Average	4.0580	4.2403	0.7873	1.3178	0.0923	0.1357	0.0559	0.0570	0.7983	2.5062	3.0519	-16.88%

Station 14: Sawahan												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.3332	5.1467	2.2503	1.5724	0.2079	0.2108	0.0671	0.0671	0.7983	4.1930	3.9477	6.21%
2	5.3646	5.4114	2.1508	1.6880	0.2065	0.2113	0.0671	0.0671	0.7983	4.1914	4.1592	0.77%
3	5.4941	5.7315	2.2674	1.5889	0.2102	0.2124	0.0671	0.0671	0.7983	4.3196	4.3743	-1.25%
4	5.3988	5.6826	2.2726	1.6053	0.2153	0.2135	0.0671	0.0671	0.7983	4.2721	4.3472	-1.73%
5	4.9633	5.0959	2.0942	1.5700	0.2116	0.2081	0.0671	0.0671	0.7983	3.9154	3.9003	0.39%
6	4.9226	4.9340	2.1272	1.5247	0.2084	0.2008	0.0671	0.0671	0.7983	3.8810	3.7475	3.56%
7	5.1277	5.1112	1.9902	1.6245	0.2014	0.1962	0.0671	0.0671	0.7983	3.9743	3.8706	2.68%
8	5.7634	5.7381	2.1266	2.0376	0.2072	0.2018	0.0671	0.0671	0.7983	4.4724	4.4126	1.36%
9	6.3763	6.3042	2.2931	2.4154	0.2159	0.2146	0.0671	0.0671	0.7983	4.9785	4.9415	0.75%
10	6.4753	6.5613	2.5917	2.7369	0.2240	0.2240	0.0671	0.0671	0.7983	5.1384	5.2250	-1.66%
11	6.1747	6.1544	2.5324	2.4634	0.2216	0.2246	0.0671	0.0671	0.7983	4.9007	4.8853	0.32%
12	5.3373	5.6433	2.2265	2.1198	0.2109	0.2179	0.0671	0.0671	0.7983	4.2032	4.4293	-5.10%
Average	5.5609	5.6262	2.2436	1.9122	0.2117	0.2113	0.0671	0.0671	0.7983	4.3700	4.3534	0.52%

Station 15: Semarang												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.2014	5.3005	1.6172	2.4457	0.2106	0.2049	0.0673	0.0673	0.9950	4.0037	4.2371	-5.51%
2	5.4599	5.2423	1.6730	2.3189	0.2104	0.2034	0.0673	0.0673	0.9025	4.1915	4.1428	1.18%
3	5.7082	5.5064	1.6147	2.4916	0.2122	0.2081	0.0673	0.0673	0.7983	4.3596	4.3576	0.05%
4	5.6160	5.4208	1.6120	2.4792	0.2132	0.2151	0.0673	0.0673	0.9950	4.3044	4.3648	-1.38%
5	5.0986	4.9156	1.6117	2.3540	0.2085	0.2135	0.0673	0.0673	0.9950	3.9225	3.9762	-1.35%
6	4.8996	4.9754	1.5855	2.3529	0.2015	0.2124	0.0673	0.0673	0.9950	3.7504	4.0146	-6.58%
7	5.1218	5.1410	1.6134	2.0773	0.1964	0.2060	0.0673	0.0673	0.9025	3.8826	4.0318	-3.70%
8	5.7589	5.8039	1.9851	2.1640	0.2015	0.2129	0.0673	0.0673	0.7983	4.4141	4.5294	-2.55%
9	6.3437	6.4006	2.3250	2.2624	0.2126	0.2206	0.0673	0.0673	0.7983	4.9427	5.0087	-1.32%
10	6.5333	6.4839	2.6180	2.5439	0.2216	0.2257	0.0673	0.0673	0.9025	5.1910	5.1582	0.64%
11	6.1189	6.1788	2.3958	2.5696	0.2223	0.2206	0.0673	0.0673	0.9950	4.8687	4.9413	-1.47%
12	5.6160	5.1768	2.0754	2.2824	0.2167	0.2086	0.0673	0.0673	0.9950	4.4205	4.1273	7.10%
Average	5.6230	5.5455	1.8939	2.3618	0.2106	0.2127	0.0673	0.0673	0.9227	4.3543	4.4075	-1.24%

Appendix IV.f: Method 4 with linear interpolation

Station 20: Tosari												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.4650	4.1342	2.0160	1.2689	0.2109	0.1262	0.0543	0.0548	0.7983	4.4292	2.9476	50.26%
2	5.6078	4.1391	1.9864	1.2098	0.2108	0.1266	0.0543	0.0548	0.7983	4.5319	2.9397	54.16%
3	5.6627	3.8941	1.9317	1.1433	0.2103	0.1266	0.0543	0.0548	0.7983	4.5628	2.7668	64.91%
4	5.5239	3.7252	1.8624	0.9936	0.2078	0.1238	0.0543	0.0548	0.7983	4.4379	2.6088	70.11%
5	5.0000	3.4304	1.5911	1.0335	0.1995	0.1211	0.0543	0.0548	0.7983	3.9714	2.4148	64.46%
6	4.7089	3.2681	1.6639	1.1159	0.1930	0.1171	0.0543	0.0548	0.7983	3.7433	2.3107	62.00%
7	4.8225	3.4519	1.9491	1.1824	0.1867	0.1120	0.0543	0.0548	0.7983	3.8508	2.4129	59.59%
8	5.3966	3.8079	2.2852	1.2481	0.1909	0.1126	0.0543	0.0548	0.7983	4.3443	2.6523	63.79%
9	6.1202	4.3035	2.5707	1.4959	0.1995	0.1181	0.0543	0.0548	0.7983	4.9616	3.0555	62.38%
10	6.3663	4.4957	2.7109	1.5559	0.2097	0.1231	0.0543	0.0548	0.7983	5.2109	3.2245	61.60%
11	6.1845	3.7752	2.5203	1.2508	0.2144	0.1249	0.0543	0.0548	0.7983	5.0635	2.7046	87.22%
12	5.6509	3.9958	2.1077	1.2643	0.2101	0.1259	0.0543	0.0548	0.7983	4.5804	2.8554	60.41%
Average	5.5424	3.8684	2.0996	1.2302	0.2036	0.1215	0.0543	0.0548	0.7983	4.4740	2.7411	63.41%

Station 22: Yogyakarta												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.7844	5.2393	1.7259	1.6076	0.1915	0.2113	0.0664	0.0665	5.6577	4.0572	4.2194	-3.84%
2	4.9828	5.4036	1.9382	1.7635	0.1948	0.2124	0.0664	0.0665	5.1602	4.3281	4.4312	-2.33%
3	5.1774	5.3706	1.9205	1.7454	0.1962	0.2140	0.0664	0.0665	4.4197	4.3583	4.3696	-0.26%
4	4.9582	5.3246	1.9690	2.1286	0.1967	0.2206	0.0664	0.0665	4.7437	4.3097	4.6813	-7.94%
5	4.7037	4.8216	1.9654	1.7953	0.1935	0.2092	0.0664	0.0665	3.5289	4.0364	4.0225	0.35%
6	4.2980	4.4835	1.8928	2.2269	0.1842	0.2039	0.0664	0.0665	3.8412	3.7781	4.1512	-8.99%
7	4.7346	4.6288	1.9169	2.5997	0.1776	0.1977	0.0664	0.0665	4.1768	4.0571	4.5650	-11.13%
8	5.3464	4.9327	1.8096	2.3693	0.1759	0.1967	0.0664	0.0665	4.4197	4.3016	4.5896	-6.28%
9	5.8094	5.3509	1.9643	2.8543	0.1833	0.2092	0.0664	0.0665	4.8941	4.7285	5.3018	-10.81%
10	5.8346	5.5071	1.9413	2.8491	0.1912	0.2240	0.0664	0.0665	5.5767	4.7833	5.4974	-12.99%
11	5.2446	5.7194	1.7407	2.3253	0.1904	0.2263	0.0664	0.0665	5.1139	4.2702	5.1051	-16.35%
12	4.9987	5.4740	1.8226	1.8249	0.1904	0.2070	0.0664	0.0665	4.8941	4.2039	4.4958	-6.49%
Average	5.0727	5.1880	1.8839	2.1742	0.1888	0.2110	0.0664	0.0665	4.7022	4.2677	4.6192	-7.26%

Station 24: Tegal												
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	gamma (IP)	gamma (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.1563	5.4455	1.8834	1.8642	0.1861	0.2168	0.0673	0.0673	6.5370	4.4372	4.6136	-3.82%
2	5.1308	4.9566	1.8307	1.6658	0.1850	0.2108	0.0673	0.0673	6.9767	4.3908	4.1739	5.20%
3	5.2899	6.1037	1.8886	1.9467	0.1885	0.2206	0.0673	0.0673	5.3800	4.4361	4.9915	-11.13%
4	5.1115	5.1923	1.8809	2.3466	0.1923	0.2184	0.0673	0.0673	5.2875	4.3412	4.8418	-10.34%
5	4.6672	5.5127	1.7935	2.5375	0.1907	0.2097	0.0673	0.0673	4.9982	4.0103	5.1348	-21.90%
6	4.6279	4.7590	1.8188	2.8244	0.1885	0.2065	0.0673	0.0673	4.9982	4.0092	4.9792	-19.48%
7	4.8214	5.1106	1.6033	2.9989	0.1826	0.2054	0.0673	0.0673	4.6974	3.8815	5.2546	-26.13%
8	5.4468	5.8115	1.7731	3.2424	0.1886	0.1997	0.0673	0.0673	4.5470	4.3610	5.8019	-24.83%
9	5.9628	6.2557	1.8980	3.5570	0.1951	0.2168	0.0673	0.0673	5.3800	4.8002	6.4933	-26.07%
10	5.9834	6.0749	2.1172	3.3121	0.1997	0.2240	0.0673	0.0673	4.9404	4.9960	6.0888	-17.95%
11	5.7418	5.1778	2.0868	2.7414	0.1962	0.2173	0.0673	0.0673	5.1486	4.8507	5.1565	-5.93%
12	5.0348	5.5296	1.8392	2.4268	0.1885	0.2234	0.0673	0.0673	5.5999	4.2771	5.1332	-16.68%
Average	5.2479	5.4942	1.8678	2.6220	0.1902	0.2141	0.0673	0.0673	5.3742	4.3993	5.2219	-14.92%

Appendix IV.g: Method 5 with linear interpolation

Station 1: Bandung										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8284	5.1659	1.0500	1.6448	0.1479	0.1717	1.0992	3.3806	3.8985	-13.28%
2	4.8011	5.2584	1.1143	1.6572	0.1482	0.1731	1.0992	3.3836	3.9707	-14.79%
3	4.7761	5.2344	1.0054	1.5767	0.1492	0.1735	1.0992	3.3422	3.9357	-15.08%
4	4.4619	4.9172	0.9941	1.3783	0.1480	0.1717	1.0992	3.1313	3.6614	-14.48%
5	4.1493	4.5708	0.8379	1.2750	0.1458	0.1690	1.0992	2.8750	3.3894	-15.18%
6	4.0065	4.3545	0.8692	1.2340	0.1419	0.1624	1.0992	2.7729	3.2043	-13.46%
7	4.2356	4.6803	0.7902	1.3029	0.1369	0.1582	1.0992	2.8624	3.4158	-16.20%
8	4.7821	5.1449	1.1032	1.7053	0.1412	0.1624	1.0992	3.3249	3.8535	-13.72%
9	5.1314	5.4824	1.2136	2.1011	0.1457	0.1717	1.0992	3.6070	4.2310	-14.75%
10	5.0753	5.5118	1.3719	1.6984	0.1499	0.1722	1.0992	3.6440	4.1471	-12.13%
11	4.9493	5.2931	1.2701	1.4571	0.1487	0.1690	1.0992	3.5267	3.9199	-10.03%
12	4.6309	5.1263	1.1098	1.8384	0.1475	0.1772	1.0992	3.2699	3.9483	-17.18%
Average	4.6523	5.0617	1.0608	1.5724	0.1459	0.1693	1.0992	3.2600	3.7980	-14.19%

Appendix IV.g: Method 5 with linear interpolation

Station 2: Bogor										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8766	4.6907	1.7209	1.7833	0.1750	0.1972	0.7983	3.6540	3.6315	0.62%
2	5.0336	4.9496	1.5777	1.5593	0.1750	0.1956	0.7983	3.7314	3.7654	-0.90%
3	5.1330	5.2112	1.7103	1.6904	0.1771	0.1982	0.9025	3.8469	3.9928	-3.65%
4	5.0041	5.1765	1.7811	1.8195	0.1799	0.2008	0.9950	3.7998	4.0156	-5.37%
5	4.6187	4.7296	1.7951	1.8160	0.1800	0.2002	0.9025	3.5307	3.6899	-4.31%
6	4.4305	4.6345	1.8325	1.7759	0.1761	0.1956	0.9025	3.3964	3.5984	-5.61%
7	4.7689	4.8889	2.0692	1.9767	0.1741	0.1936	0.9950	3.6880	3.8245	-3.57%
8	5.3304	5.4534	2.0980	2.2211	0.1757	0.1962	0.9950	4.0765	4.2804	-4.76%
9	5.8221	6.0858	2.1574	2.5140	0.1788	0.2023	0.9950	4.4360	4.8124	-7.82%
10	5.7042	5.9812	1.9731	2.3041	0.1793	0.2039	1.2033	4.3399	4.7317	-8.28%
11	5.3600	5.4953	2.0421	2.1672	0.1813	0.2023	0.9950	4.1093	4.3224	-4.93%
12	4.9205	4.9633	1.8127	2.0146	0.1763	0.1987	0.9025	3.7226	3.8890	-4.28%
Average	5.0836	5.1883	1.8808	1.9702	0.1774	0.1987	0.9487	3.8610	4.0462	-4.41%

Station 3: Curug-Budiarto										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.9604	5.6402	1.6760	2.5139	0.2064	0.2263	0.7983	3.8191	4.5296	-15.69%
2	5.1177	5.8752	1.6195	2.2786	0.2061	0.2257	0.7983	3.9186	4.6578	-15.87%
3	5.5499	5.9779	1.7019	2.4197	0.2091	0.2274	0.7983	4.2531	4.7633	-10.71%
4	5.3898	5.8124	1.7525	2.5894	0.2114	0.2321	0.7983	4.1581	4.6885	-11.31%
5	4.9621	5.2352	1.9439	2.3414	0.2102	0.2303	0.7983	3.8833	4.2189	-7.95%
6	4.6696	4.9718	2.0054	2.3972	0.2053	0.2263	0.7983	3.6697	4.0239	-8.80%
7	4.9202	5.2811	1.9256	2.6065	0.2017	0.2234	0.7983	3.8184	4.2754	-10.69%
8	5.5262	6.0480	2.1312	2.6403	0.2043	0.2263	0.7983	4.2939	4.8476	-11.42%
9	6.0209	6.6896	2.3856	2.8225	0.2096	0.2303	0.7983	4.7141	5.3622	-12.09%
10	5.9236	6.5814	2.4179	2.7144	0.2166	0.2315	0.7983	4.6803	5.2697	-11.18%
11	5.5298	6.1849	2.2346	3.0427	0.2146	0.2362	0.7983	4.3573	5.0521	-13.75%
12	5.1972	5.6371	1.9111	2.6798	0.2073	0.2286	0.7983	4.0333	4.5638	-11.62%
Average	5.3140	5.8279	1.9754	2.5872	0.2086	0.2287	0.7983	4.1333	4.6877	-11.76%

Station 4: Djember										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.7565	5.4930	1.7780	1.8738	0.1746	0.2065	0.7983	3.5666	4.2366	-15.81%
2	5.0156	5.6608	1.6951	1.8768	0.1757	0.2065	0.7983	3.7292	4.3561	-14.39%
3	4.9478	5.6639	1.6609	1.8865	0.1747	0.2070	0.7983	3.6719	4.3624	-15.83%
4	4.8140	5.3560	1.5196	1.7492	0.1723	0.2034	0.7983	3.5412	4.1031	-13.69%
5	4.1942	4.8111	1.2981	1.2670	0.1658	0.1946	0.7983	3.0507	3.5926	-15.08%
6	4.0109	4.4246	1.2374	1.2318	0.1591	0.1872	0.7983	2.8868	3.2864	-12.16%
7	4.0965	4.4718	1.1877	1.2888	0.1534	0.1791	0.7983	2.9035	3.2950	-11.88%
8	4.4762	5.0756	1.2661	1.6508	0.1542	0.1848	0.7983	3.1699	3.8052	-16.70%
9	5.1746	5.9103	1.5218	1.9860	0.1607	0.1956	0.7983	3.7173	4.5003	-17.40%
10	5.5151	6.2654	1.6777	2.1434	0.1696	0.2028	0.7983	4.0280	4.8151	-16.35%
11	5.1361	6.0967	1.8588	2.0297	0.1743	0.2065	0.7983	3.8372	4.6930	-18.24%
12	4.9376	5.6349	2.0948	1.8691	0.1776	0.2049	0.7983	3.7670	4.3292	-12.99%
Average	4.7563	5.4053	1.5663	1.7377	0.1677	0.1982	0.7983	3.4891	4.1146	-15.04%

Station 5: Gunung Rosa										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.5866	4.2657	1.6712	1.3280	0.1827	0.1519	1.5041	3.6202	3.1689	14.24%
2	4.6401	4.4591	1.5297	1.3591	0.1825	0.1544	1.5041	3.6087	3.3134	8.91%
3	5.0979	4.8254	1.7330	1.5374	0.1883	0.1565	1.5041	4.0055	3.6204	10.64%
4	4.8365	4.7446	1.5635	1.4627	0.1868	0.1573	1.5041	3.7680	3.5460	6.26%
5	4.5800	4.3281	1.7245	1.2932	0.1867	0.1556	1.5041	3.6470	3.2123	13.53%
6	4.3417	4.1826	1.5252	1.0923	0.1795	0.1499	1.5041	3.3972	3.0196	12.50%
7	4.5737	4.4413	1.6614	1.1680	0.1770	0.1495	1.5041	3.5877	3.2074	11.86%
8	4.9153	4.8326	1.8530	1.4167	0.1766	0.1499	1.5041	3.8767	3.5468	9.30%
9	5.3419	5.0473	2.0787	1.5163	0.1837	0.1528	1.5041	4.2639	3.7336	14.20%
10	5.2170	5.3274	1.9833	1.6336	0.1881	0.1565	1.5041	4.1657	3.9738	4.83%
11	4.9559	5.0065	1.6772	1.5374	0.1861	0.1552	1.5041	3.8830	3.7287	4.14%
12	4.6685	4.2452	1.6835	1.3347	0.1844	0.1523	1.5041	3.6852	3.1603	16.61%
Average	4.8129	4.6422	1.7237	1.3900	0.1835	0.1535	1.5041	3.7924	3.4359	10.59%

Appendix IV.g: Method 5 with linear interpolation

Station 7: Karang Anjar										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.0821	5.4310	1.9464	1.5591	0.2097	0.2097	0.7983	3.9641	4.1416	-4.29%
2	5.1940	5.5307	2.1281	1.8231	0.2127	0.2135	0.7983	4.0881	4.2765	-4.41%
3	5.6245	5.4193	2.0881	1.7091	0.2153	0.2135	0.7983	4.3987	4.1766	5.32%
4	5.2688	5.5183	2.1359	1.4557	0.2159	0.2108	0.7983	4.1546	4.1897	-0.84%
5	5.1216	4.9419	2.1249	1.0830	0.2103	0.2039	0.7983	4.0271	3.6828	9.35%
6	4.6147	4.6505	2.0196	0.8220	0.2008	0.1926	0.7983	3.6153	3.3797	6.97%
7	5.0812	4.6441	2.0024	0.7889	0.1938	0.1838	0.7983	3.9108	3.3272	17.54%
8	5.5988	4.8875	2.0010	0.8942	0.1912	0.1853	0.7983	4.2573	3.5216	20.89%
9	6.0475	4.9877	2.2241	1.2327	0.2005	0.1921	0.7983	4.6575	3.6903	26.21%
10	5.9034	5.0552	2.1346	1.2728	0.2096	0.1992	0.7983	4.5815	3.7773	21.29%
11	5.4550	5.4645	1.9863	1.5262	0.2086	0.2060	0.7983	4.2317	4.1428	2.15%
12	5.3833	5.3182	2.0266	1.6452	0.2090	0.2076	0.7983	4.1900	4.0682	2.99%
Average	5.3646	5.1541	2.0682	1.3177	0.2065	0.2015	0.7983	4.1731	3.8645	8.60%

Station 9: Lembang										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.1818	4.8842	1.6458	0.9815	0.1768	0.1451	1.5041	4.0106	3.4170	17.37%
2	5.2572	4.8277	1.6455	1.0500	0.1776	0.1451	1.5041	4.0646	3.4074	19.29%
3	5.3219	4.7364	1.5931	0.9052	0.1788	0.1459	1.5041	4.0965	3.3011	24.09%
4	4.9835	4.3983	1.4430	0.8963	0.1773	0.1443	1.5041	3.8136	3.0773	23.93%
5	4.6569	4.0899	1.3898	0.7380	0.1745	0.1424	1.5041	3.5657	2.8151	26.66%
6	4.4044	3.9662	1.3742	0.7972	0.1682	0.1390	1.5041	3.3672	2.7424	22.78%
7	4.7279	4.1810	1.4230	0.7012	0.1642	0.1334	1.5041	3.5787	2.8035	27.65%
8	5.2167	4.7417	1.7964	1.0308	0.1678	0.1386	1.5041	4.0437	3.3060	22.31%
9	5.5743	5.1099	2.1797	1.1481	0.1773	0.1432	1.5041	4.4510	3.6077	23.38%
10	5.5904	5.0242	1.8199	1.3176	0.1783	0.1471	1.5041	4.3485	3.6418	19.41%
11	5.3270	4.9329	1.5707	1.2192	0.1751	0.1459	1.5041	4.0753	3.5410	15.09%
12	5.1688	4.6557	1.8635	1.0530	0.1822	0.1447	1.5041	4.0956	3.2988	24.15%
Average	5.1176	4.6290	1.6454	0.9865	0.1748	0.1429	1.5041	3.9593	3.2466	22.18%

Station 10: Magelang										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.3018	4.9836	1.8632	1.6867	0.2089	0.1972	0.7983	4.1383	3.8320	7.99%
2	5.3809	5.2164	1.9535	2.0714	0.2098	0.2044	0.7983	4.2144	4.0964	2.88%
3	5.4247	5.3032	1.9745	1.9593	0.2120	0.2044	0.7983	4.2587	4.1382	2.91%
4	5.3987	5.0995	2.0889	1.8456	0.2167	0.2028	0.7983	4.2777	3.9661	7.86%
5	4.8785	4.7893	1.8129	1.8338	0.2093	0.2028	0.7983	3.8269	3.7430	2.24%
6	4.6774	4.5696	1.9513	1.5551	0.2041	0.1936	0.7983	3.6888	3.5017	5.34%
7	4.7951	4.9413	2.0268	1.6022	0.1972	0.1843	0.7983	3.7616	3.7307	0.83%
8	5.1995	5.2661	1.9726	1.5334	0.1993	0.1872	0.7983	4.0459	3.9566	2.26%
9	5.6031	5.9418	2.3018	2.0596	0.2090	0.1977	0.7983	4.4326	4.5802	-3.22%
10	5.7162	6.0225	2.3979	1.9464	0.2190	0.2013	0.7983	4.5702	4.6343	-1.38%
11	5.8082	5.7146	2.2234	1.9569	0.2199	0.2018	0.7983	4.6111	4.4197	4.33%
12	5.3445	5.5005	1.9300	1.9049	0.2077	0.1982	0.7983	4.1758	4.2420	-1.56%
Average	5.2941	5.2790	2.0414	1.8296	0.2094	0.1980	0.7983	4.1668	4.0701	2.54%

Station 11: Pangerango										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.4579	3.7359	1.1064	0.3718	0.1421	0.0818	2.0016	3.3400	2.1227	57.35%
2	4.4066	3.8143	1.3052	0.4183	0.1431	0.0830	2.0016	3.3961	2.2021	54.22%
3	4.2865	3.7108	1.1849	0.4640	0.1452	0.0835	2.0016	3.2770	2.1800	50.32%
4	4.0473	3.7036	1.1853	0.5189	0.1464	0.0857	2.0016	3.1270	2.2283	40.33%
5	3.8058	3.6076	1.3256	0.8940	0.1468	0.0880	2.0016	3.0297	2.4085	25.79%
6	3.8560	3.5346	1.3914	1.0534	0.1431	0.0860	2.0016	3.0768	2.4461	25.78%
7	3.8291	4.0205	1.6713	1.3687	0.1400	0.0852	2.0016	3.1685	2.8741	10.24%
8	4.7280	4.3702	1.3674	1.2900	0.1397	0.0852	2.0016	3.6124	3.0111	19.97%
9	4.5730	4.6063	1.7389	1.0142	0.1447	0.0847	2.0016	3.6929	2.9716	24.27%
10	5.5684	4.4591	1.8076	0.6374	0.1482	0.0828	2.0016	4.3854	2.6575	65.02%
11	5.1228	4.1402	1.4047	0.4563	0.1470	0.0820	2.0016	3.9214	2.3810	64.70%
12	3.5397	3.8441	1.2696	0.3680	0.1458	0.0806	2.0016	2.8298	2.1632	30.82%
Average	4.3518	3.9623	1.3965	0.7379	0.1443	0.0840	2.0016	3.4048	2.4705	39.07%

Appendix IV.g: Method 5 with linear interpolation

Station 12: Pasuruan										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	4.8560	5.5105	1.6287	2.2890	0.1731	0.2151	0.9950	3.6085	4.3865	-17.74%
2	4.9814	5.6219	1.5411	2.1671	0.1723	0.2146	1.2033	3.6802	4.4659	-17.59%
3	4.7775	5.7563	1.5147	2.0367	0.1731	0.2124	0.9025	3.5202	4.4825	-21.47%
4	4.6020	5.7544	1.3762	1.8877	0.1707	0.2081	1.2033	3.3782	4.4576	-24.21%
5	4.3283	5.2443	1.2290	1.8447	0.1658	0.2013	1.2958	3.1389	4.0788	-23.04%
6	4.1230	5.0626	1.2388	1.9076	0.1593	0.1951	1.4000	2.9908	3.9652	-24.57%
7	4.3673	5.2315	1.2944	2.3896	0.1522	0.1907	1.5967	3.1394	4.2588	-26.28%
8	4.9036	5.8640	1.5662	2.8841	0.1554	0.1951	1.8049	3.6073	4.9208	-26.69%
9	5.5483	6.5770	1.8118	3.0557	0.1633	0.2002	2.0942	4.1700	5.5400	-24.73%
10	5.7265	6.7447	2.0722	3.2261	0.1724	0.2118	1.8975	4.4219	5.7069	-22.52%
11	5.1416	6.4222	1.8775	3.0677	0.1753	0.2184	1.5041	3.9398	5.3517	-26.38%
12	4.9308	5.7242	1.7517	2.4350	0.1747	0.2162	1.2033	3.7221	4.6129	-19.31%
Average	4.8572	5.7928	1.5752	2.4326	0.1673	0.2066	1.4251	3.6098	4.6856	-22.88%

Station 13: Rarahan										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	3.8694	4.4375	0.4529	0.9945	0.0904	0.1334	0.7983	2.2731	3.0945	-26.54%
2	3.9412	4.3479	0.4996	1.2729	0.0914	0.1349	0.7983	2.3363	3.1068	-24.80%
3	3.8505	4.1312	0.5294	1.0888	0.0920	0.1363	0.7983	2.2999	2.9341	-21.61%
4	3.8108	3.8727	0.5782	1.1016	0.0940	0.1378	0.7983	2.3088	2.7760	-16.83%
5	3.6859	3.6543	0.9082	1.2469	0.0958	0.1382	0.7983	2.3436	2.6661	-12.10%
6	3.6019	3.7393	1.0568	1.3556	0.0936	0.1349	0.7983	2.3190	2.7293	-15.03%
7	4.0600	3.6664	1.3231	1.6530	0.0924	0.1316	0.7983	2.6396	2.7324	-3.40%
8	4.4341	4.6626	1.2841	1.2447	0.0929	0.1308	0.7983	2.8432	3.2785	-13.28%
9	4.6888	4.3698	1.0560	1.6345	0.0930	0.1356	0.7983	2.9245	3.2047	-8.74%
10	4.5505	5.5817	0.7351	1.7447	0.0916	0.1393	0.7983	2.7439	4.0460	-32.18%
11	4.2496	5.1154	0.5621	1.3094	0.0908	0.1382	0.7983	2.5198	3.6379	-30.73%
12	3.9527	3.3045	0.4624	1.1666	0.0894	0.1375	0.7983	2.3119	2.4162	-4.32%
Average	4.0580	4.2403	0.7873	1.3178	0.0923	0.1357	0.7983	2.4886	3.0519	-17.46%

Station 14: Sawahan										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.3332	5.1467	2.2503	1.5724	0.2079	0.2108	0.7983	4.1922	3.9477	6.19%
2	5.3646	5.4114	2.1508	1.6880	0.2065	0.2113	0.7983	4.1906	4.1592	0.75%
3	5.4941	5.7315	2.2674	1.5889	0.2102	0.2124	0.7983	4.3187	4.3743	-1.27%
4	5.3988	5.6826	2.2726	1.6053	0.2153	0.2135	0.7983	4.2713	4.3472	-1.75%
5	4.9633	5.0959	2.0942	1.5700	0.2116	0.2081	0.7983	3.9146	3.9003	0.37%
6	4.9226	4.9340	2.1272	1.5247	0.2084	0.2008	0.7983	3.8803	3.7475	3.54%
7	5.1277	5.1112	1.9902	1.6245	0.2014	0.1962	0.7983	3.9735	3.8706	2.66%
8	5.7634	5.7381	2.1266	2.0376	0.2072	0.2018	0.7983	4.4715	4.4126	1.33%
9	6.3763	6.3042	2.2931	2.4154	0.2159	0.2146	0.7983	4.9775	4.9415	0.73%
10	6.4753	6.5613	2.5917	2.7369	0.2240	0.2240	0.7983	5.1373	5.2250	-1.68%
11	6.1747	6.1544	2.5324	2.4634	0.2216	0.2246	0.7983	4.8998	4.8853	0.30%
12	5.3373	5.6433	2.2265	2.1198	0.2109	0.2179	0.7983	4.2024	4.4293	-5.12%
Average	5.5609	5.6262	2.2436	1.9122	0.2117	0.2113	0.7983	4.3691	4.3534	0.50%

Station 15: Semarang										
Month	alpha (IP)	alpha (CfM)	beta (IP)	beta (CfM)	delta (IP)	delta (CfM)	u2 (M)	ETo (CfI)	ETo (CfM)	Error in ETo
1	5.2014	5.3005	1.6172	2.4457	0.2106	0.2049	0.9950	4.0032	4.2371	-5.52%
2	5.4599	5.2423	1.6730	2.3189	0.2104	0.2034	0.9025	4.1909	4.1428	1.16%
3	5.7082	5.5064	1.6147	2.4916	0.2122	0.2081	0.7983	4.3589	4.3576	0.03%
4	5.6160	5.4208	1.6120	2.4792	0.2132	0.2151	0.9950	4.3037	4.3648	-1.40%
5	5.0986	4.9156	1.6117	2.3540	0.2085	0.2135	0.9950	3.9220	3.9762	-1.36%
6	4.8996	4.9754	1.5855	2.3529	0.2015	0.2124	0.9950	3.7499	4.0146	-6.59%
7	5.1218	5.1410	1.6134	2.0773	0.1964	0.2060	0.9025	3.8820	4.0318	-3.72%
8	5.7589	5.8039	1.9851	2.1640	0.2015	0.2129	0.7983	4.4134	4.5294	-2.56%
9	6.3437	6.4006	2.3250	2.2624	0.2126	0.2206	0.7983	4.9420	5.0087	-1.33%
10	6.5333	6.4839	2.6180	2.5439	0.2216	0.2257	0.9025	5.1904	5.1582	0.62%
11	6.1189	6.1788	2.3958	2.5696	0.2223	0.2206	0.9950	4.8681	4.9413	-1.48%
12	5.6160	5.1768	2.0754	2.2824	0.2167	0.2086	0.9950	4.4199	4.1273	7.09%
Average	5.6230	5.5455	1.8939	2.3618	0.2106	0.2127	0.9227	4.3537	4.4075	-1.26%

Appendix IV.g: Method 5 with linear interpolation

Station 20: Tosari										
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.4650	4.1342	2.0160	1.2689	0.2109	0.1262	0.7983	4.4225	2.9476	50.04%
2	5.6078	4.1391	1.9864	1.2098	0.2108	0.1266	0.7983	4.5250	2.9397	53.93%
3	5.6627	3.8941	1.9317	1.1433	0.2103	0.1266	0.7983	4.5558	2.7668	64.66%
4	5.5239	3.7252	1.8624	0.9936	0.2078	0.1238	0.7983	4.4309	2.6088	69.84%
5	5.0000	3.4304	1.5911	1.0335	0.1995	0.1211	0.7983	3.9649	2.4148	64.19%
6	4.7089	3.2681	1.6639	1.1159	0.1930	0.1171	0.7983	3.7372	2.3107	61.73%
7	4.8225	3.4519	1.9491	1.1824	0.1867	0.1120	0.7983	3.8448	2.4129	59.34%
8	5.3966	3.8079	2.2852	1.2481	0.1909	0.1126	0.7983	4.3378	2.6523	63.55%
9	6.1202	4.3035	2.5707	1.4959	0.1995	0.1181	0.7983	4.9543	3.0555	62.14%
10	6.3663	4.4957	2.7109	1.5559	0.2097	0.1231	0.7983	5.2035	3.2245	61.37%
11	6.1845	3.7752	2.5203	1.2508	0.2144	0.1249	0.7983	5.0563	2.7046	86.95%
12	5.6509	3.9958	2.1077	1.2643	0.2101	0.1259	0.7983	4.5736	2.8554	60.17%
Average	5.5424	3.8684	2.0996	1.2302	0.2036	0.1215	0.7983	4.4672	2.7411	63.16%

Station 22: Yogyakarta										
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	4.7844	5.2393	1.7259	1.6076	0.1915	0.2113	5.6577	4.0567	4.2194	-3.86%
2	4.9828	5.4036	1.9382	1.7635	0.1948	0.2124	5.1602	4.3276	4.4312	-2.34%
3	5.1774	5.3706	1.9205	1.7454	0.1962	0.2140	4.4197	4.3577	4.3696	-0.27%
4	4.9582	5.3246	1.9690	2.1286	0.1967	0.2206	4.7437	4.3093	4.6813	-7.95%
5	4.7037	4.8216	1.9654	1.7953	0.1935	0.2092	3.5289	4.0360	4.0225	0.34%
6	4.2980	4.4835	1.8928	2.2269	0.1842	0.2039	3.8412	3.7777	4.1512	-9.00%
7	4.7346	4.6288	1.9169	2.5997	0.1776	0.1977	4.1768	4.0567	4.5650	-11.13%
8	5.3464	4.9327	1.8096	2.3693	0.1759	0.1967	4.4197	4.3009	4.5896	-6.29%
9	5.8094	5.3509	1.9643	2.8543	0.1833	0.2092	4.8941	4.7278	5.3018	-10.83%
10	5.8346	5.5071	1.9413	2.8491	0.1912	0.2240	5.5767	4.7826	5.4974	-13.00%
11	5.2446	5.7194	1.7407	2.3253	0.1904	0.2263	5.1139	4.2695	5.1051	-16.37%
12	4.9987	5.4740	1.8226	1.8249	0.1904	0.2070	4.8941	4.2033	4.4958	-6.51%
Average	5.0727	5.1880	1.8839	2.1742	0.1888	0.2110	4.7022	4.2672	4.6192	-7.27%

Station 24: Tegal										
Month	**alpha (IP)**	**alpha (CfM)**	**beta (IP)**	**beta (CfM)**	**delta (IP)**	**delta (CfM)**	**u2 (M)**	**ETo (CfI)**	**ETo (CfM)**	**Error in ETo**
1	5.1563	5.4455	1.8834	1.8642	0.1861	0.2168	6.5370	4.4375	4.6136	-3.82%
2	5.1308	4.9566	1.8307	1.6658	0.1850	0.2108	6.9767	4.3911	4.1739	5.20%
3	5.2899	6.1037	1.8886	1.9467	0.1885	0.2206	5.3800	4.4365	4.9915	-11.12%
4	5.1115	5.1923	1.8809	2.3466	0.1923	0.2184	5.2875	4.3416	4.8418	-10.33%
5	4.6672	5.5127	1.7935	2.5375	0.1907	0.2097	4.9982	4.0106	5.1348	-21.89%
6	4.6279	4.7590	1.8188	2.8244	0.1885	0.2065	4.9982	4.0095	4.9792	-19.48%
7	4.8214	5.1106	1.6033	2.9989	0.1826	0.2054	4.6974	3.8820	5.2546	-26.12%
8	5.4468	5.8115	1.7731	3.2424	0.1886	0.1997	4.5470	4.3615	5.8019	-24.83%
9	5.9628	6.2557	1.8980	3.5570	0.1951	0.2168	5.3800	4.8008	6.4933	-26.07%
10	5.9834	6.0749	2.1172	3.3121	0.1997	0.2240	4.9404	4.9965	6.0888	-17.94%
11	5.7418	5.1778	2.0868	2.7414	0.1962	0.2173	5.1486	4.8511	5.1565	-5.92%
12	5.0348	5.5296	1.8392	2.4268	0.1885	0.2234	5.5999	4.2775	5.1332	-16.67%
Average	5.2479	5.4942	1.8678	2.6220	0.1902	0.2141	5.3742	4.3997	5.2219	-14.91%